

REMARKS

In response to the Official Action mailed June 5, 2002, Applicants respectfully request that the Examiner reconsider the rejection of the claims.

Claims 1-17 and 22-25 stand rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to point out and distinctly claim the subject matter believed to be the invention. Applicants respectfully traverse these rejections.

Pursuant to 37 C.F.R. §132, Applicants provide attached as Exhibit 1 the Affidavit of Professor Scott Russell of the University of Oklahoma and President of the Botanical Society of America ("the Russell Affidavit"). In the Russell Affidavit, Page 2, Professor Russell explains that one skilled in the art would clearly understand the meaning of the claim terms "established" and "adult." Specifically, the Russell Affidavit explains that these terms are used consistently with their standard definitions found in conventional morphology and botany text books.

In sum, since one skilled in the art would understand the language of the claims, in light of the specification, Applicant respectfully traverses the rejections under 35 U.S.C. §112.

Claims 1, 2, 4, 5, 7, 10, 15, and 22-25 stand rejected under 35 U.S.C. § 102(b) as being anticipated by *Mehra-Palta*, (U.S. Patent 4,417,417). Applicants respectfully traverse these rejections in view of the Russell Affidavit.

A rejection under 35 U.S.C. § 102(b) requires identity of invention. In other words, each and every limitation must be explicitly disclosed in a single cited prior art reference. However, as Professor Russell explains in the section of the Russell Affidavit beginning at the end of Page 2 and continuing to the middle of Page 4, *Mehra-Palta* is directed to substantially different subject matter. To summarize Professor Russell's analysis, without repeating the extensive detail he has provided, *Mehra-Palta* discloses an *in vitro* embryogenetic process for generating new plantlets which uses cytokinin to produce adventitious buds (nascent stems and associated leaves), rather

than roots. Auxin is only used by *Mehra-Palta* after the plantlets are produced. In fact, Professor Russell notes that adding cytokinin with auxin under *Mehra-Palta* would result in a failure of the production of stems from the calluses, which defeats the purposes of the *Mehra-Palta* patent, which is to produce new plants *in vitro*.

In other words, *Mehra-Palta* does disclose the stimulation of roots *in situ* to rescue distressed trees. Given the lack of identity of invention between Applicants' claims and the disclosure of *Mehra-Palta*, Applicants respectfully note that the rejections under 35 U.S.C. § 102 cannot stand.

Additionally, Claims 18 and 21 stand rejected under 35 U.S.C. § 102(b) as being anticipated by *Dale*, (Article "*Fred Dale Special to the Star*"). Professor Russell addresses *Dale* on Page 4 of the Russell Affidavit. In sum, Professor Russell notes that *Dale* does not describe treating native trees *in situ*, and in fact, the *Dale* transplantation method would actually result in tree death when applied to the distressed trees subject of Applicants invention. Applicants therefore also respectfully traverse the rejections of Claims 18 and 21 under 35 U.S.C. § 102(b).

Applicant also provides an unsworn letter from Professor James Seago of the State University of New York as Exhibit 2 hereto. Professor Seago provides an additional point of view in regard to the differences between the claimed invention and the disclosures of *Dale* and *Mehra-Palta*. Generally, Professor Seago explains the differences in mixtures which would be required to stimulate trees like post oaks (per embodiments of the present invention) and conifers (per *Mehra-Palta*). He also notes that the effects of the procedures disclosed in *Dale* also differ from the effects induced by application of Applicants' inventive principles.

Claims 3, 6, 8, 9, 11-14, 16 and 17 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Mehra-Palta*., Applicants respectfully traverse these rejections in view of the Russell Affidavit, the Cooper Affidavit (Exhibit 3) and the Martin Affidavit, attached hereto as Exhibit 4 and which evidences commercial success of Applicants' invention.

Professor Russell notes, among other things, in the section beginning on Page 4 of the Russell Affidavit, various non-obvious differences between the claimed invention and the techniques of *Mehra-Palta*. For example, Professor Russell notes that a small plantlets cannot be fairly compared with trees of 10 to 50 years in age. He also generally notes that the selection of cytokinins, auxins, hormones and fungicides for a various applications is a non-trivial task, requiring careful analysis of the desired effect and the harmony of the selected compounds with the biological system as a whole.

Exhibit 3 is an Affidavit submitted under 37 C.F.R. § 132 from John Cooper, horticulturist for Denton County, Texas ("the Cooper Affidavit"). The Cooper Affidavit includes an attachment which summarizes the effects of urban blight on oak trees. Cooper avers that in his practice as horticulturist in a county having a significant number of trees, he has not used nor experienced the use of a distress tree treatment such as that developed by the Applicants.

Commercial success is a well known secondary indicator of non-obviousness. Applicants therefore provide attached as Exhibit 4 an Affidavit under 37 C.F.R. §132 from Peter Martin discussing the commercial success of embodiments of the present invention. To summarize, in less that two years, the invention has reaped between \$5000 and \$10000 a month during the growing season. Interest in Applicants' invention has significantly increased, especially since a successful treatment of a distressed tree can enhance the value of wooded property.

No new matter has been added, merely amended to more particularly point out and distinctly claim the subject matter Applicants believe is inventive.

Applicants respectfully submit that the Claims as they now stand are patentably distinct over the allowed Claims of the parent application and the art cited during the prosecution thereof.


With the addition of no new claims, no additional filing fees are due. However, Applicants respectfully request a One Month Extension of Time to File Response as

attached with Extension Request Fees in the amount of \$55.00 and attached pto/sb/17 Fee Transmittal confirming Small Entity Status.

Also, the Commissioner is hereby authorized to charge any fees or credit any overpayment to Deposit Account Number 23-2426 of WINSTEAD SECHREST & MINICK P.C.

If the Examiner has any questions or comments concerning this paper or the present application in general, the Examiner is invited to call the undersigned at (214) 745-5374.

Respectfully submitted,
WINSTEAD SECHREST & MINICK P.C.
Attorneys for Applicants

By: 
James J. Murphy
Reg. No. 34,503

5400 Renaissance Tower
1201 Elm Street
Dallas, Texas 75270
(214) 745-5374
Attorney's Docket: 22601- P002US
Date: October 7, 2002



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Smith, et al.

Serial No.: 9/660,257

Filed: 09/12/2000

Title: METHODS AND MIXTURES FOR TREATING DISTRESSED TREES

Art Unit: 3643

Examiner: Gellner



Hon. Commissioner of Patents
Box Fee Amendment
Washington, D. C. 20231.

#9/Affidavit
1/4

RECEIVED
OCT 11 2002
GROUP 3600

Certificate of Mailing *Express Mail*

I hereby state that on reasonable information and belief, I expect that this correspondence will be deposited with the U.S. Postal Service as U.S. ~~first class~~ ^{EXPRESS} mail with sufficient postage, in an envelope addressed to the Commissioner for Patents, Washington, D.C. 20231, on the date indicated below.

R. Taylor
Signature

Sarah Taylor Gellner
Printed Name

Oct. 7, 2007
Date

EXPRESS MAIL Receipt No. EL859426400US

AFFIDAVIT

WHEREAS, the undersigned,

I, Scott D. Russell, resident of 3001 Oak Tree Ave. #D14, Norman, County of Cleveland, Oklahoma 73072-8038 do hereby state that :

I am George Lynn Cross Research Professor of Botany; and Director of Samuel Roberts Noble Microscopy Laboratory at the University of Oklahoma in Norman, Oklahoma. In addition, I am Managing Editor of *Sexual Plant Reproduction* and President of the Botanical Society of America.

The applicants Dr. Don Smith and Peter Martin requested that I examine the patent application for "Methods and mixtures for treating distressed trees" attorney docket 22601-P002US. While I am not trained in the legal aspects of the challenges to his application, I have restrained myself to matters of botanical knowledge. My background is that of a professional botanist. My

Affidavit of Scott D. Russell

In support of the Patent Application; Applicants: Smith, et al.; Serial No.: 9/660,257

Page 2 of 5

curriculum vita is available for inspection on the web at <http://www.ou.edu/cas/botany-micro/faculty/sdr-vita.shtml> and has been included as a separate attachment to this filing and includes all education, publications, presentations, and recognitions that I have received to date.

I have attached a point-by-point examination of the findings of the United States Patent and Trademark Office in rejecting Dr. Smith's patent application.

If there are any questions regarding these findings, I can be reached at the address and contacts given above.

This is in response to the Office Communication from the US Patent and Trademark Office on 22601-P002US, mailed 06/05/2002.

Claims 1-25 are rejected largely on the basis that (1) the claims do not distinctly delineate the subject matter which the applicant regards as the invention, (2) others held the patent rights or (3) the techniques were obvious to one skilled in the art at the time of the application. In fact, neither is true, as existing patents relate to plant propagation and the art does not address problems of native tree interactions in soil conditions in artificially modified environments.

Regarding the rejection of claims on the basis that the claims do not distinctly delineate the subject matter which the applicant regards as the invention:

- 1) "Established" plants can be described specifically and an objective standard can be obtained because it is dependent on the plant reaching maturity and bearing extensive secondary growth as defined in all conventional botany texts and plant structure resources currently available.
- 2) "Adult" plants is clearly described in morphology texts as consisting of (1) a syndrome of progressive changes in leaf organization (called heteroblasty) that range from juvenile leaves (starting just above the cotyledonary node of the seedling) to a stable mature form at sexual maturity; (2) onset of production of appropriate sexual organs.

Regarding the rejection of claims on the basis that others held the patent rights:

- 1) The most critical existing patents is 4,417,417 of Mehra-Palta, which is used to reject Claims 1, 2, 4, 5, 7, 10, 15, 22-25. This patent concerns the use of a cytokinin hormone to stimulate the formation of adventitious buds until these produce rootable shoots in gymnosperms. The procedure also included pulse treatment in a phenolic compound and an auxin to produce roots subsequently. The critical points follow:
 - a) Mehra-Palta (4,417,417) exclusively uses culture media *in vitro* on tissue culture cells, not organisms. *In vitro* preparation involves severing a part of the plant from an existing plant and each plant part creates a new plant. The creation of a separate plant does not anticipate the rescue of an existing parent plant.

- b) In *in vitro* culture, differentiation is preceded by the formation of an undifferentiated tissue called **callus** that lacks organs and any indication of organography. This means that the material cannot be distinguished as root or stem. There is no evidence for the formation of callus in roots of post oak. The method of production of plantlets is described as an **embryogenetic process** involving the production of polarized embryoids.
- c) The claim of Mehra-Palta is the production of **adventitious buds via cytokinin treatment**. Buds are defined as nascent stems with their associated leaves. Smith claimed proliferation of roots via cytokinin and auxin treatment. Mehra-Palta makes no claim that cytokinins produce roots.
- d) Mehra-Palta use a pulse of auxin only once plantlets are produced. The auxin is added to stimulate the stems created by the cytokinin treatment to form roots.
- e) This patent does not anticipate the combination of cytokinins with auxin. In fact, if they added the two components, the callus would never produce stems and therefore the principal goal of the patent would not be achieved. Stimulation of **stems** created using the cytokinin procedure to produce roots occurs **subsequent to shoot formation**.
- f) The Smith claims are based on stimulating the formation of **roots from roots** in vivo, creating a **rescue situation** where an **adult plant is maintained in situ** under circumstances in which it would normally die. No claim is made that stems (adventitious buds) are produced from the root. There is no embryogenetic process involved. Vegetative proliferation is the sole effect, and this from tissue that is already differentiated as solely root.
- g) If the Smith application followed protocols of Mehra-Palta, a small segment of a tree would need to be removed to culture tissue from the plant. This material would form new plants in culture that could be planted in the place of the old plant. The old plant, however, would still be dead or dying. This does not meet the goals of the Smith patent application. (It seems reasonable to comment that producing new trees using seed would be easier and more cost effective than using the Mehra-Palta method.)
- h) "Establishment" in the sense of Mehra-Palta means living tissues that can be introduced into the environment as independent plants. "Establishment" in the sense of Smith means mature trees with extensive periderm and rhytidome accumulation (bark), which for oaks would typically be significantly in excess of 10 years.
- i) Mehra-Palta patent 4,417,417 never uses the word "distressed" to describe either individual plants or species. A close examination of the patent indicates that they are not interested in saving individual plants, but reproducing genetically superior plants using a faster method than available in the past. Further, they are interested in selecting genetically superior plants for culture. Smith is interested in saving trees subjected to the stress of environments altered by man.

- j) In the sense of Mehra-Palta it could be anticipated that "distressed" plants would not be selected for culture as plants that are not performing well in their environment would not produce suitably superior genetic plants and therefore would not be selected for further research or cloning.
 - k) The patent did not address plants to be established in the environment. Their protocol assumed that "normal treatment" (not discussed in their patent) would be required after their introduction into the environment. Thus, the Mehra-Palta patent does not anticipate the treatment of plants in soil.
- 2) Claims 18 and 21 are rejected on the basis of anticipation of the technique by Dale (Fred Dale Special to the Star).
- a) Dale described transplanting commercially-available horticulturally bred trees of typically three to five years of age. In contrast, Smith describes treating native plant species of typically 10 or more years of age, *in situ*.
 - b) Use of transplantation as described by Dale would result in tree death, and is also quite impractical for trees that have accumulated over a ton of biomass. It is further unclear why the article by Dale is a priority description for cyclic watering.

Regarding the rejection of claims on the basis that the techniques were obvious to one skilled in the art at the time of the application:

- 1) Regarding Claim 3, it is not obvious that a 1000-cell plantlet would replace a 10-50 year old tree.
- 2) Regarding Claim 6, alteration of N, P and K concentrations to specific numbers is not obvious and is the subject of study and experimentation under field conditions. Mehra-Palta did not describe or advocate specific N, P or K concentrations on sexually mature plants.
- 3) Regarding Claims 8 & 9 and 16 & 17, suitability of a specific fungicide is obvious, but determining the harmony of a specific fungicide with regard to a specific application is not obvious and is the subject of study and experimentation under field conditions.
- 4) Regarding Claims 11-13 and 14, Mehra-Palta described an entirely different application of hormones presented in pulses with the goal of establishing plantlets from tissue culture. The cytokinin was designed to stimulate buds, which are stems and leaves. Smith used cytokinin to cause existing roots (not stems or roots) to proliferate. In tissue culture, the use of Smith's protocol would not result in the formation of plantlets if cytokinin was used simultaneously with auxin.
- 5) Regarding Claim 19, the Smith proposal applies both auxin and cytokinin and is therefore distinct from prior state-of-the-art, which would contend that use of both would be counterproductive for roots in tissue culture.

Affidavit of Scott D. Russell

In support of the Patent Application; Applicants: Smith, et al.; Serial No.: 9/660,257

Page 5 of 5

- 6) Regarding Claim 20, the use of a water jet is not obvious as it is the subject of study and experimentation under field conditions.

Note: The views expressed on these pages represent those of the above person and do not necessarily reflect the views of, or represent endorsements by, the University of Oklahoma, the journal *Sexual Plant Reproduction* or the Botanical Society of America.

I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

The Commissioner is hereby authorized to charge any fees or credit any overpayment to Deposit Account Number 23-2426 of WINSTEAD SECHREST & MINICK P.C.

If the Examiner has any questions or comments concerning this paper or the present application in general, the Examiner is invited to call the attorney for the patent applicants, James J. Murphy at (214) 745-5374.

Maker of Affidavit's signature:

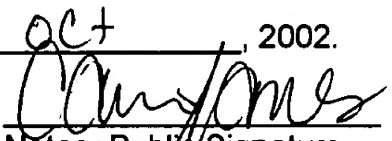
State of Oklahoma

§
§


Scott D. Russell

Before me, Carrie Jones, a notary public, on this day personally appeared 10-01-02, known to me to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same for the purposes and considerations therein expressed.

Given under my hand and seal on the 1 day of Oct, 2002.


Notary Public Signature
Carrie Jones
Notary Public Printed Name

Inventor's signature:

State of TEXAS

§
§
§




Peter Martin

County of Denton_____

Before me, Sarah Taylor Lenz Cliff, a notary public, on this day
personally appeared Peter Martin, known to me to be the person(s)
whose name(s) is/are subscribed to the within instrument and acknowledged to me that
he/she/they executed the same for the purposes and considerations therein expressed.

Given under my hand and seal on the _____ day of _____, 2002.



Notary Public Signature

Sarah Taylor Lenz Cliff

Notary Public Printed Name

CURRICULUM VITAE SCOTT D. RUSSELL

- General Information
 - Education
 - Professional Experience
 - Honors
 - Research Funding
 - External
 - Internal
 - Instructional
 - Teaching
 - Publications
 - Scientific Publications
 - Scientific Presentations
 - Invited Presentations
 - Published Abstracts
-

CURRICULUM VITAE SCOTT D. RUSSELL

DATE OF BIRTH: December 8, 1952
PLACE OF BIRTH: Milwaukee, Wisconsin
MARITAL STATUS: Divorced, one child, Eric (1988)

EDUCATION:

<u>Years</u>	<u>School</u>	<u>Degree</u>
1975	University of Wisconsin-Madison	B.A. in Botany
1977	Northern Arizona University-Flagstaff	M.S. in Biology
1981	University of Alberta-Edmonton, Canada	Ph.D. in Botany

PROFESSIONAL EXPERIENCE:

<u>Years</u>	<u>Organization</u>	<u>Position Held</u>
1976-1977	Northern Arizona University	Teaching Assistant
1977-1980	University of Alberta	Teaching Assistant
1980-1981	University of Alberta	Predoctoral Fellow
1981-1982	University of Oklahoma	Acting Assist.Professor
1982-1987	University of Oklahoma	Assistant Professor
1989	École Normale Supérieure de Lyon	Chair privée
1987-1992	University of Oklahoma	Associate Professor
1992-2000	University of Oklahoma	Professor
1997	University of Melbourne	Visiting Professor
1984-	Samuel Roberts Noble Electron Microscopy	Director

present Laboratory
2000- University of Oklahoma
present

George Lynn Cross Research
Professor

HONORS:

- 1980-81 University of Alberta Dissertation Fellowship
1986-87 OU Associates Distinguished Lecturer
1987
Focus on Excellence - Samuel Roberts Noble Electron Microscopy Laboratory - O.U. Faculty Senate
1988
Jeanette Siron Pelton award for sustained and imaginative research in experimental plant morphology, Botanical Society of America
1992
Diatome Award for best electron microscopic work on sectioned biological or physical sciences specimens at the annual meeting of the Electron Microscopy Society of America, second prize with H.-S. Yu.
1994
Regents' Award for Superior Research and Creative Activity, University of Oklahoma.
1997
Microscopy Society of America Award for best microscopic poster in the biological sciences at the annual meeting of the Microscopy Society of America, second prize with Z. Zhang.
1998
Special Service Award for efforts in website development and inaugurating *American Journal of Botany* online, Botanical Society of America.
2000
George Lynn Cross Research Professorship, University of Oklahoma.
2001
Special Service Award for efforts in website development, Botanical Society of America.
2001-02
President-Elect, Botanical Society of America.
2001-
Managing Editor, *Sexual Plant Reproduction*.
2002-
President, Botanical Society of America.

Awards to Students

- 1997
Dissertation Award presented to Stephen D. Fields for his dissertation entitled "Ultrastructural and physiological analysis of the nascent symbiosis between *Gymnodinium acidotum* (Dinophyceae) and *Chroomonas* sp. (Cryptophyceae)" Ph.D., April 1996

TEACHING:

- General Botany (BOT 1114)
- Cell Biology (BOT/MBIO/ZOOL 3113)
- Plant Anatomy (BOT 4283)
- Transmission Electron Microscopy (BOT/MBIO/ZOOL 5364)
- Scanning Electron Microscopy (BOT/MBIO/ZOOL 5374)
- Comparative Morphology of Vascular Plants (BOT 5624)
- College of Liberal Studies Introductory Seminars (BLS program)
- Special Courses in Freeze Fracture Electron Microscopy and Scientific Graphics
- Independent Study courses in Plant Anatomy, Electron Microscopy and Plant Cell Biology
- Graduate Supervision

PAPERS IN SCIENTIFIC PUBLICATIONS:

| 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997
| 1998 | 1999 | 2000 | 2001 | 2002 |

1. Russell, S. D. 1979. Fine structure of megagametophyte development in *Zea mays*. Can. J. Bot. 57: 1093-1110.
2. Russell, S. D. 1980. Participation of male cytoplasm during gamete fusion in an angiosperm. *Plumbago zeylanica*. Science (Washington, D.C.) 210: 200-201.
3. Russell, S. D. and D. D. Cass. 1981. Ultrastructure of fertilization in *Plumbago zeylanica*. Invited paper of the VI Symposium on Plant Cytoembryology. Lublin, Poland. Acta Societatis Botanicorum Poloniae. 50: 185-189.
4. Russell, S. D. and D. D. Cass. 1981. Ultrastructure of the sperms of *Plumbago zeylanica*. I. Cytology and association with the vegetative nucleus. Protoplasma 107: 85-107.

5. Russell, S. D. 1982. Fertilization in *Plumbago zeylanica*: Entry and discharge of the pollen tube within the embryo sac. *Can. J. Bot.* 60:2219-2230.
6. Russell, S. D. and D. J. Peteya. 1982. A simple, rapid method of staining grids for transmission electron microscopy. *Ok-SEM Bull.* 4(2):9-10.
7. Russell, S. D. and D. D. Cass. 1982. Unequal distribution of plastids and mitochondria during sperm cell formation in *Plumbago zeylanica*. In: *Pollen: biology and implications for plant breeding*. Ed. D. L. Mulcahy and E. Ottoviano. Elsevier Biomedical. New York. pp. 135-140.
8. Russell, S. D. 1983. Fertilization in *Plumbago zeylanica*: Gametic fusion and fate of the male cytoplasm. *Amer. J. Bot.* 70:416-434.
9. Russell, S. D. 1983. Gametic fusion in *Plumbago*. *BioScience* 33: 390.
10. Russell, S. D. and D. D. Cass. 1984. Ultrastructure of gamete fusion in *Plumbago zeylanica*. Invited paper of the VII Symposium on Embryogenesis of Ovulated Plants. Bratislava, Czechoslovakia. pp. 245-248.
11. Russell, S. D. 1984. Timetable of fertilization. *Pollination '84 Symposium volume*. University of Melbourne, Melbourne, Australia. pp. 69-77.
12. Russell, S. D. 1984. Ultrastructure of the sperms of *Plumbago zeylanica*. 2. Quantitative cytology and three-dimensional organization. *Planta* 162:385-391.
13. Russell, S. D. 1984. An aid to calculating amounts of fixative. *Ok-SEM Newsletter* 6(1):11.
14. Russell, S. D. and M. Ehdai. 1984. Megagametophyte development in *Nandina domestica* and its taxonomic implications. *Phytomorphology* 34:221-225.
15. Dumas, C., R. B. Knox, C. A. McConchie and S. D. Russell. 1984. Emerging physiological concepts in fertilization. *What's New in Plant Physiology* 15:17-20.
16. Russell, S. D. 1985. Sperm-specificity in *Plumbago zeylanica*. *Proceedings of VIII Symposium on Sexual Reproduction in seed plants, ferns and mosses*. PUDOC, Wageningen, Netherlands. pp. 145-146.
17. Russell, S. D. 1985. Preferential fertilization in *Plumbago*: ultrastructural evidence for gamete-level recognition in an angiosperm. *Proceedings of the National Academy of Science (USA)*. 82:6129-6132.
18. Russell, S. D. and C. P. Daghljan. 1985. Scanning electron microscopic observations on deembedded biological tissue sections: comparison of different fixatives and embedding materials. *Journal of Electron Microscopy Technique* 2: 489-496.
19. Brandenberg, D. M., S. D. Russell, J. R. Estes and W. F. Chissoe. 1985. Backscattered electron imaging as a technique for visualizing silica bodies in the grasses. *SEM, Inc. Chicago, Ill. Vol. IV*: 1509-1517.
20. Russell, S. D. 1986. Biphasic pollen tube growth in *Plumbago zeylanica*. *Pollen Biotechnology and Ecology*. D. L. Mulcahy (ed.) Springer-Verlag, New York: pp. 385-390.
21. Russell, S. D. 1986. Dimorphic sperm cells, cytoplasmic transmission, and preferential fertilization in the synergid-less angiosperm. *Plumbago zeylanica*. In: *The Chondrome*. Longman, London. pp. 69-116.
22. Russell, S. D. 1986. A method for the isolation of sperm cells in *Plumbago zeylanica*. *Plant Physiology* 81: 317-319.
23. Russell, S. D. and T. W. Mislan. 1986. Microtubule-organelle associations during generative cell polarization in *Plumbago zeylanica*. *Electron Microscopy* 44: 280-281.
24. McConchie, C. A., S. D. Russell, C. Dumas, M. Touhy and R. B. Knox. 1987. Quantitative cytology of the mature sperm cells of *Brassica campestris* and *B. oleracea*. *Planta* 170: 446-452.
25. Russell, S. D. 1987. Quantitative cytology of the egg and central cell of *Plumbago zeylanica* and its impact on cytoplasmic inheritance patterns. *Theoretical and Applied Genetics* 74: 693-699.
26. Pennell, R. I., N. R. Geltz, E. Koren, and S. D. Russell. 1987. Production and partial characterization of hybridoma antibodies elicited to the sperm of *Plumbago zeylanica*. *Botanical Gazette* 148: 401-406.
27. Russell, S. D. Fertilization. 1987 *Yearbook of Science and Technology*. McGraw-Hill, New York. pp. 197-199.
28. Secor, D. L. and S. D. Russell. 1988. Organization of the megagametophyte in a polyembryonic line of *Linum usitatissimum*. *American Journal of Botany* 75: 114-122.
29. Russell, S. D. and D. D. Cass. 1988. Fertilization in *Plumbagella micrantha*. *American Journal of Botany*. 75:778-781.
30. Russell, S. D., G. W. Strout, R. A. Thompson, T. W. Mislan and L. M. Schoemann. 1988. Polarization in the generative cell of *Plumbago zeylanica*. In: *Flowering plant sperm cells: prospects for breeding and biotechnology*. (H. J. Wilms and C. J. Keijzer, eds) PUDOC, Netherlands, pp. 17-26.
31. Geltz, N. R. and S. D. Russell. 1988. Two-dimensional electrophoretic studies of the proteins and polypeptides in mature pollen grains and the male germ unit of *Plumbago zeylanica*. *Plant Physiology* 88: 764-769.
32. Russell, S. D. 1989. Fertilization in *Plumbago zeylanica* - a review. *Phytomorphology* 39:1-20.
33. Russell, S. D., B. Q. Huang and G. W. Strout. 1989. Intermediate voltage transmission electron microscopic observations of isolated embryo sacs of *Plumbago zeylanica*. In: *Festschrift for Professor Dr. A. Lebegue, Universite de Picardie*, (J. Pare, N. Bugnicourt and J. Mortier, eds.) pp. 109-119.
34. Huang, B. Q. and S. D. Russell. 1989. Isolation of fixed and viable eggs, central cells, and embryo sacs of *Plumbago zeylanica*. *Plant Physiology* 90: 9-12.
35. Russell, S. D., G. W. Strout, and D. M. Hurd. 1989. Mitosis and cytokinesis in higher plant cells: Scanning electron microscopic observations of deplastized sections. *Electron Microscopy Society of America Proceedings* 47: 980-981.
36. Strout, G. W. and S. D. Russell. 1990. A micro-sample critical point drying apparatus for small specimens. *Journal of Electron Microscopy Technique* 14:175-176.
37. Russell, S. D. 1990. A method for improved resolution for fluorescence microscopy using plastic-embedded material subjected to resin extraction. *Stain Technology* 65:259-261.
38. Roedel, P., A. Chaboud, E. Matthys-Rochon, S. Russell and C. Dumas. 1990. Sperm cell structure, development and organization. In: *Microspores-evolution and ontogeny*, (S. Blackmore and R. B. Knox, eds.) Academic Press, London, pp. 281-307.
39. Russell, S. D. 1990. Three-dimensional reconstruction in generative cell development and sperm organization: importance, methodology and results. In: *Characterization of male transmission units in higher plants* (B. Barnabus K. Liszt, eds.) Agricultural Research Institute of the Hungarian Academy of Sciences, Budapest, pp. 3-7.
40. Tiezzi, A., A. Moscatelli, M. Murgia, S. Russell, C. del Casino, A. Barteles, and M. Cresti. 1990. Immunofluorescence studies on microtubules in the generative cell using confocal scanning laser microscopy. *Characterization of male transmission units in higher plants*. (B. Barnabus K. Liszt, ed). Agricultural Research Institute of the Hungarian Academy of Sciences, Budapest, pp. 17-21.

41. Russell, S. D., M. Rougier, and C. Dumas. 1990. Organization of the early post-fertilization megagametophyte of *Populus deltoides*: Ultrastructure and implications for male cytoplasmic transmission. *Protoplasma* 155:153-165.
42. Russell, S. D. 1990. Isolation and characterization of the angiosperm gamete. NATO Ast Series. Series H. Cell Biology Vol. 45 In: Mechanism of fertilization: plants to man. (B. Dale, ed.) Springer-Verlag, Heidelberg, pp. 3-15.
43. Russell, S. D. and Mao L.-J. 1990. Patterns of embryo sac organization, synergid degeneration and cotyledon orientation in *Linum usitatissimum*. *Planta* 182: 52-57.
44. Russell, S. D., M. Cresti, and C. Dumas. 1990. Recent progress on sperm characterization in flowering plants. *Physiol. Plantarum* 80: 669-675.
45. Huang, B.-Q., S. D. Russell, G. W. Strout, and Mao L.-J. 1990. Organization of isolated embryo sac and eggs of *Plumbago zeylanica* (Plumbaginaceae) before and after fertilization. *Amer. J. Bot.* 77:1401-1410.
46. Russell, S. D. 1990. Energy-dispersive x-ray microanalysis of cellular components in the pollen of an angiosperm, *Plumbago zeylanica*. XII International Congress for Electron Microscopy Proceedings pp. 804-805.
47. Russell, S. D. 1991. Isolation and characterization of sperm cells in flowering plants. *Annual Review of Plant Physiology and Plant Molecular Biology* 42: 189-204.
48. Rougier, M., N. Jnoud, C. Said, S. Russell and C. Dumas. 1991. Male gametophyte development and formation of the male germ unit of *Populus deltoides* after self-pollination. *Protoplasma* 162:140-150.
49. Huang, B.-Q., and S. D. Russell. 1992. Synergid degeneration in *Nicotiana*: A quantitative, fluorochromatic and chlorotetracycline study. *Sexual Plant Reproduction* 5: 151-155.
50. Huang, B.-Q., E. S. Pierson, S. D. Russell, A. Tiezzi, and M. Cresti. 1992. Video microscopic observations of living, isolated embryo sacs of *Nicotiana* and their component cells. *Sexual Plant Reproduction* 5: 156-162.
51. Rougier, M., N. Jnoud, C. Said, S. Russell, and C. Dumas. 1992. Interspecific incompatibility in *Populus*: inhibition of tube growth and male germ unit behavior in *Populus deltoides* x *P. alba* cross. *Protoplasma* 168: 107-112.
52. Dumas, C. and S. D. Russell. 1992. Plant reproductive biology: trends. *International Review of Cytology*. 140:565-592.
53. Huang, B.-Q., and S. D. Russell. 1992. Female germ unit: organization, isolation and function. *International Review of Cytology* 140: 233-293.
54. Russell, S. D. 1992. Double fertilization. *International Review of Cytology* 140: 357-388.
55. Russell, S. D. and C. Dumas. (eds.) 1992. "Sexual Reproduction in Flowering Plants", a supplemental issue to the *International Review of Cytology*. Academic Press, New York, 615 pp.
56. Yu, H. S., S.-Y. Hu, and S. D. Russell. 1992. Sperm cells in pollen tubes of *Nicotiana tabacum* L.: Three-dimensional reconstruction, cytoplasmic diminution and quantitative cytology. *Protoplasma* 168: 172-183.
57. Brandenburg, D. M., J. R. Estes, S. D. Russell and J. W. Thieret. 1992. One-nerved paleas in *Cinna arundinaceae* L. (Poaceae). *Transactions of the Kentucky Academy of Science*.
58. Watson, B. S., J. S. Fletcher and S. D. Russell. 1992. A morphometric analysis of suspension cultures of Paul's scarlet rose cells. *Plant Cell Tissue and Organ Culture* 31: 37-46.
59. Yu, H.-S. and S. D. Russell. 1992. Male cytoplasmic diminution and male germ unit in young and mature pollen of *Cymbidium goeringii*: a 3-dimensional and quantitative study. *Sexual Plant Reproduction* 5: 169-181.
60. Yu, H.-S. and S. D. Russell. 1992. Generative cell mitosis in pollen tubes of *Nicotiana tabacum*: ultrastructure and three-dimensional reconstruction. *Proceedings of the 50th Annual Meeting of the Electron Microscopy Society of America*, pp. 848-849.
61. Huang, B.-Q., and S. D. Russell. 1993. Polarity of nuclear and plastid DNA during megasporogenesis and megagametogenesis in *Plumbago zeylanica*. *Sexual Plant Reproduction* 6: 205-211.
62. Huang, B.-Q., E. S. Pierson, S. D. Russell, A. Tiezzi, and M. Cresti. 1993. Cytoskeletal organization and modification in the process of fertilization of *Plumbago zeylanica*. *Zygote* 1:143-154.
63. Russell, S.D. 1993. The egg cell: development and role in fertilization and early embryogenesis. *Plant Cell* 5:1349-1359.
64. Huang, B.-Q., G. W. Strout and S. D. Russell. 1993. Fertilization in *Nicotiana tabacum*: Ultrastructural organization of propane jet-frozen embryo sacs in vivo. *Planta* 191:256-264.
65. Yu, H.-S. and S. D. Russell. 1993. Three dimensional ultrastructure of generative cell mitosis in pollen tubes of *Nicotiana*. *European Journal of Cell Biology*. 61:338-348.
66. Fields, S. D., G. W. Strout and S. D. Russell. 1993. Spray-freezing apparatus for cryofixation of unicellular algae. *Proceedings of the 51st Annual Meeting of the Microscopy Society of America*, pp. 134-135.
67. Bedinger, P. and S. D. Russell. 1994. Megasporogenesis and megametogenesis in corn. In *Maize Handbook* (M. Freeling and V. Walbot, eds.), Springer-Verlag, New York, pp. 48-61.
68. Russell, S. D. and D. P. West. 1994. Protocols for studying megasporogenesis and megametogenesis in corn. In *Maize Handbook* (M. Freeling and V. Walbot, eds.), Springer-Verlag, New York, pp. 135-139.
69. Yu, H.-S. and S. D. Russell. 1994. Populations of plastids and mitochondria during male reproductive cell maturation in *Nicotiana tabacum* L.: a cytological basis for occasional biparental inheritance. *Planta* 193:115-122.
70. Yu, H.-S. and S. D. Russell. 1994. Male reproductive cell development in pollen tubes of *Nicotiana tabacum*: male germ unit associations and quantitative cytology during sperm maturation. *Sexual Plant Reproduction* 7:324-332.
71. Yu, H.-S., B.-Q. Huang and S. D. Russell. 1994. Transmission of male cytoplasm during fertilization in *Nicotiana tabacum*. *Sexual Plant Reproduction* 7:312-323.
72. Huang, B.-Q. and S. D. Russell. 1994. Fertilization in *Nicotiana tabacum*: Cytoskeletal modifications in the embryo sac during synergid degeneration. A hypothesis for short distance transport of sperm cells prior to gamete fusion. *Planta* 194:200-214.
73. Russell, S.D. 1994. Fertilization in higher plants. In *Pollen-Pistil Interactions*. *Proceedings of the 9th Annual Penn State Symposium in Plant Physiology*, American Society of Plant Physiology, Washington, D.C., pp. 99-111.
74. Yu, H.-S. and S. D. Russell. 1994. Quantitative differences in sperm cells and organelles of tobacco (*Nicotiana tabacum* L.) grown under differing environmental conditions. *Theoretical and Applied Genetics* 89: 7814-817.
75. Yu, H.-S., and S. D. Russell. 1994. Occurrence of mitochondria in the nuclei of *Nicotiana tabacum* sperm cells. *Plant Cell* 6:1477-1484.
76. Russell, S. D. 1994. Fine structure of megagametophyte development. In: *Embryology of Flowering Plants: Terminology and Concepts. Volume I. Generative Organs of Flowers*, Professor Tatyana B. Batygina, Editor, pp. 202-206. World and Family Publishers, St. Petersburg, Russia. 1994. (Received in October 1995)

77. Russell, S. D., G. W. Strout, A. K. Stramski, T. W. Mislan, R. A. Thompson and L. M. Schoemann. 1996. Development polarization and morphogenesis of the generative and sperm cells of *Plumbago zeylanica*. 1. Descriptive cytology and three-dimensional organization. *American Journal of Botany* 83: 1435-1453.
78. Cao, Y., A. Reece and S.D. Russell. 1996. Isolation of sperm cells of *Nicotiana tabacum*. *Zygote* 4: 81-84.
79. Russell, S.D. 1996. Attraction and transport of male gametes for fertilization. *Sexual Plant Reproduction* 9: 337-342.
80. Cao, Y. and S. D. Russell. 1997. Mechanical isolation and ultrastructural characterization of viable egg cells in *Plumbago zeylanica*. *Sexual Plant Reproduction* 10: 368-373
81. Fields, S. D., G.W. Strout, and S. D. Russell. 1997. Spray-freezing freeze substitution (SFFS) of cell suspensions for improved preservation of ultrastructure. *Microscopy Research and Technique* 38: 315-328
82. Tian, H.Q. and S.D. Russell. 1997. Development changes in calcium distribution and accumulation in fertilized and unfertilized ovules and embryo sacs of *Nicotiana tabacum*. *Planta* 202: 93-105.
83. Tian, H.Q. and S.D. Russell. 1997. Micromanipulation of male and female gametes of *Nicotiana tabacum*: I. Isolation of gametes. *Plant Cell Reports* 16: 555-560.
84. Tian, H.Q. and S.D. Russell. 1997. Micromanipulation of male and female gametes of *Nicotiana tabacum*: II. Preliminary attempts for in vitro fertilization and egg cell culture. *Plant Cell Reports* 16: 657-661
85. Southworth, D., G. W. Strout and S. D. Russell. 1997. Freeze fracture of *Plumbago zeylanica* L. sperm in pollen and in vitro. *Sexual Plant Reproduction* 10: 217-226
86. Zhang, Z. and S. D. Russell. 1997. Immunofluorescent localization of myosin on the sperm cells of *Plumbago zeylanica*. *Proceedings of the Microscopy Society of America meetings*, pp. 183-184
87. Russell, S. D. 1998. Biology of the angiosperm male gamete and its role in fertilization. *Acta Agronomica Hungarica* 46: 409-413.
88. Russell, S.D. 1998. "Cytoplasmic transmission during fertilization" for the volume "Anther" in the book, *Modern Embryology. Terminology and Concepts*, Professor T. Batygina, editor. Komorov Botanical Institute, Leningrad, USSR, pp. 169-175.
89. Russell, S.D. 1998. "Fertilization mechanisms in flowering plants" for the volume "Anther" in the book, *Modern Embryology. Terminology and Concepts*, Professor T. Batygina, editor. Komorov Botanical Institute, Leningrad, USSR, pp. 186-192.
90. Russell, S.D. 1998. "In vitro fertilization in flowering plants" for the volume "Anther" in the book, *Modern Embryology. Terminology and Concepts*, Professor T. Batygina, editor. Komorov Botanical Institute, Leningrad, USSR, pp. 210-211.
91. Russell, S.D. 1998. "The male germ unit" for the volume "Anther" in the book, *Modern Embryology. Terminology and Concepts*, Professor T. Batygina, editor. Komorov Botanical Institute, Leningrad, USSR, pp. 127-135.
92. Tian, H. Q., A. Kuang, M. E. Musgrave, and S. D. Russell. 1998. Calcium distribution in fertile and sterile anthers of a photoperiod-sensitive genic male-sterile rice. *Planta* 205: 183-192.
93. Tian, H.Q., Z. Zhang, and S. D. Russell. 1998. Isolation of the male germ unit (MGU): organization and function in tobacco (*Nicotiana tabacum* L.). *Plant Cell Reports* 18: 143-147.
94. Tian, H.Q. and S. D. Russell. 1998. The fusion of sperm cells and the function of male germ unit (MGU) of tobacco (*Nicotiana tabacum* L.) *Sexual Plant Reproduction* 11: 171-176.
95. Zhang, Z. and S. D. Russell. 1998. Isolation and collection of two populations of viable sperm cells from the pollen of *Plumbago zeylanica* *Zygote* 6: 295-298.
96. Huang BQ, Sheridan WF, Russell SD. 1999. Cytoskeletal and nuclear behavior during female gametophyte development and fertilization in angiosperms. In: "Focus on Multidimensional Microscopy", Cheng PC, Hwang PP, Wu JL, Wang G (eds.). World Scientific Publ Co Pte Ltd., Singapore, pp. 89-97.
97. Okada T, Zhang Z, Russell SD, Toriyama K. 1999. Localization of the Ca²⁺-binding protein, Bra r 1, in anthers and pollen tubes. *Plant Cell Physiology* 40: 1243-1252.
98. Tian HQ, Russell SD. 1999. Culture-induced changes in osmolality of tobacco cell suspensions using four exogenous sugars. *Plant Cell, Tissue and Organ Culture* 55: 9-13.
99. Zhang Z, Russell SD. 1999. Sperm cell surface characteristics of *Plumbago zeylanica* in relation to transport in the embryo sac. *Planta* 208: 539-544.
100. Zhang Z, Tian HQ, Russell SD. 1999. Immunogold scanning electron microscopic localization of myosin on isolated sperm cells of tobacco (*Nicotiana tabacum* L.) *Protoplasma* 208: 123-128.
101. Tian HQ, Zhu H, Russell SD. 2000. Developmental changes in calcium distribution and accumulation in fertilized and unfertilized ovules and embryo sacs of *Plumbago zeylanica*. *Sexual Plant Reproduction* 13: 11-20.
102. Russell SD. 2001. Female gametogenesis: Ontogenesis of the embryo sac and female gametes. In: "Current Trends in the Embryology of Angiosperms," Bhojwani S, Soh WY (eds), Kluwer Academic Publishers, Dordrecht, The Netherlands, pp. 65-88.
103. Southworth D, Russell SD. 2001. Male gametogenesis: Development and structure of sperm. In: "Current Trends in the Embryology of Angiosperms," Bhojwani SS, Soh WY (eds), Kluwer Academic Publishers, Dordrecht, The Netherlands, pp. 1-16.
104. Tian HQ, Zhang Z, Russell SD. 2001. Sperm dimorphism in *Nicotiana tabacum* L. *Sexual Plant Reproduction* 14: 123-125.
105. Singh MB, Xu H, Bhalla P, Zhang Z, Swoboda I, Russell SD. 2002. Developmental expression of polyubiquitin genes and distribution of ubiquitinated proteins in generative and sperm cells. *Sexual Plant Reproduction* 14: 325-329.
106. Lord EM, Russell SD. 2002. Mechanisms of pollination and fertilization. *Annual Review of Cell and Developmental Biology* 18: (in press)

PAPERS PRESENTED AT PROFESSIONAL MEETINGS:

1978

With D. D. Cass. Post-fertilization development in *Plumbago zeylanica*. Botanical Society of America Annual Meetings, Blacksburg, Virginia.

1979

Developmental modifications of sperm structure during pollen tube growth in *Plumbago zeylanica*. American Institute of Biological Sciences Annual Meetings, Stillwater, Oklahoma.

- 1980 Gamete delivery and syngamy in Plumbago zeylanica. Botanical Society of America/Canadian Botanical Association Annual Meetings, Vancouver, British Columbia, Canada
- 1980 With D. D. Cass. "Ultrastructure of fertilization in Plumbago zeylanica". VI Symposium on Plant Cytoembryology, Lublin, Poland. (Presented by D. D. Cass.)
- 1981 Structure and quantitative cytology of male gametes in Plumbago zeylanica. XIII. International Botanical Congress, Sydney, Australia.
- 1981 Gamete delivery and gamete fusion in the flowering plant Plumbago zeylanica. Oklahoma Academy of Science/Oklahoma Society for Electron Microscopy Annual Meetings, Enid, Oklahoma.
- 1982 With D. D. Cass. "Ultrastructure of gamete fusion in Plumbago zeylanica." VII Symposium on Embryogenesis in Ovulated Plants. Bratislava, Czechoslovakia. (Presented by D. D. Cass.)
- 1982 With D. D. Cass. "Unequal distribution of plastids and mitochondria during sperm cell formation in Plumbago zeylanica." Symposium on Pollen Biology. Lake Garda, Italy. (Presented by D. D. Cass.)
- 1982 "Quantitative cytology and stereology of male gametes and transmitted male cytoplasmic organelles in Plumbago zeylanica." Botanical Society of America Annual Meetings. College Station, Pennsylvania.
- 1983 "Gametic fusion in Plumbago zeylanica: Ultrastructural evidence for gamete recognition and the preferential transmission of sperm plastids into the zygote." Botanical Society of America/Canadian Botanical Association Annual Meetings. Grand Forks, North Dakota.
- 1983 "Evidence for gametic recognition in the angiosperm Plumbago zeylanica." Oklahoma Academy of Science/Oklahoma Society for Electron Microscopy Annual Meetings, Tulsa, Oklahoma.
- 1984 "Timetable of Fertilization." Pollination '84, University of Melbourne, Melbourne, Australia.
- 1984 "Gametic recognition in Plumbago and its implications in angiosperm reproduction." VIII Symposium on the Embryogenesis of Ovulated Plants, Wageningen, The Netherlands.
- 1984 "Three-dimensional reconstruction in the study of the male gamete of a flowering plant." Oklahoma Academy of Science/Oklahoma Society for Electron Microscopy Annual Meetings, Ada, Oklahoma.
- 1984 "Megagametophyte development in Nandina domestica Thunb. and its taxonomic implications." With M. Ehdaie. Oklahoma Academy of Science, Ada, Oklahoma.
- 1985 "Microgametogenesis in Plumbago zeylanica." Botanical Society of America annual meetings. Gainesville, Florida.
- 1985 "Biphasic pollen tube growth in Plumbago zeylanica." Biotechnology and Ecology of Pollen Symposium. Amherst, Massachusetts.
- 1985 "Development, polarization, and morphogenesis of the generative cell, and studies on sperm specificity in Plumbago zeylanica." International Conference on Angiosperm Male Gamete Structure. Flagstaff, Arizona.
- 1985 "Dimorphic sperm cells, cytoplasmic transmission and preferential fertilization in the synergid-less angiosperm, Plumbago zeylanica." The Chondriome. Second Wye International Symposium. Wye, Ashford, Kent, United Kingdom.
- 1985 "Isolation of sperm cells of Plumbago zeylanica." The Chondriome. Second Wye International Symposium. Wye, Ashford, Kent, United Kingdom.
- 1985 "Isolation of sperm cells of Plumbago zeylanica." Oklahoma Academy of Science/Oklahoma Society for Electron Microscopy Annual Meeting, Shawnee, Oklahoma.
- 1985 "Compositional analysis of tooth amalgam". With W. F. Chisoe. Oklahoma Academy of Science/Oklahoma Society for Electron Microscopy Annual meeting. Shawnee, Oklahoma.
- 1986 "Microtubule-organelle associations during generative cell polarization in Plumbago zeylanica." With T. W. Mislan. Electron Microscopy Society of America Annual Meeting. Albuquerque, New Mexico.
- 1987 "Ultrastructure of fertilization." XIV International Botanical Congress. West Berlin, Federal Republic of Germany.
- 1987 "Polarization in the generative cell of Plumbago zeylanica." Second International Conference on Flowering Plant Sperm Cells. Wageningen, Netherlands.
- 1987 "Two-dimensional electrophoretic studies of protein and polypeptides in mature pollen grains of Plumbago zeylanica." With N. R. Geltz. Oklahoma Academy of Sciences Annual Meeting. Alva, Oklahoma.
- 1987 "Isolation of embryo sacs and eggs of Plumbago zeylanica." With B. Q. Huang. Oklahoma Academy of Sciences Annual Meeting. Alva, Oklahoma.

- "Synergid degeneration in *Nicotiana*: a light, transmission and scanning electron microscopic study." With B.-Q. Huang. XII International Congress on Sexual Plant Reproduction, Columbus, Ohio.
- 1992 "The ultrastructural organization of freeze-substituted ovules of *Nicotiana tabacum* before and after fertilization." With B.-Q. Huang and G. W. Strout. XII International Congress on Sexual Reproduction, Columbus, Ohio.
- 1992 "Cytoskeletal organization within the embryo sac before and after fertilization in *Nicotiana* and *Plumbago*." With B.-Q. Huang. XII International Congress on Sexual Plant Reproduction, Columbus, Ohio.
- 1992 "Computer-assisted three-dimensional reconstruction of generative cell mitosis in pollen tubes of *Nicotiana*." With H.-S. Yu. XII International Congress on Sexual Plant Reproduction, Columbus, Ohio.
- 1992 "Three-dimensional reconstruction and quantitative cytology in pollen of *Cymbidium goeringii*." With H.-S. Yu. XII International Congress on Sexual Plant Reproduction, Columbus, Ohio.
- 1992 "Male cytoplasmic transmission during fertilization in *Nicotiana*." With B.-Q. Huang and H.-S. Yu. XII International Congress on Sexual Plant Reproduction, Columbus, Ohio.
- 1992 "Development of a spray freezing apparatus for the rapid cryofixation of a fragile, unicellular alga." With Fields, S. D. and G. W. Strout. Annual Meeting of Oklahoma Academy of Science/Oklahoma Society for Electron Microscopy, Lawton, Oklahoma.
- 1992 "Cytoskeletal organization within the embryo sac before and after fertilization in *Nicotiana*." With B.-Q. Huang. Annual Meeting of Oklahoma Academy of Science/Oklahoma Society for electron Microscopy, Lawton, Oklahoma.
- 1992 "Fertilization in flowering plants." Annual Meetings of Crop Sciences Society of America, Minneapolis, Minnesota.
- 1992 "Mitochondria entrapped within the sperm nucleus of *Nicotiana tabacum*." With H.-S. Yu. Annual meeting of Oklahoma Academy of Science/Oklahoma Society for Electron Microscopy, Lawton, Oklahoma.
- 1992 "Occurrence of mitochondria inside the sperm nucleus of tobacco." With H.-S. Yu. Annual Meeting of American Society of Cell Biology, Denver, Colorado.
- 1993 "Gametes, cytoskeleton and fertilization in angiosperms." Congress on Cell and Tissue Culture, San Diego, California.
- 1993 "Ultrastructure and three-dimensional organization of mitosis in generative cells of *Nicotiana tabacum*." With H.-S. Yu. Annual Meeting of Botanical Society of America/Canadian Botanical Association, Iowa State University, Ames, Iowa.
- 1993 "Spray-freezing apparatus for cryofixation of unicellular algae." With S. D. Fields and G. W. Strout. 51st Annual Meeting of the Microscopy Society of America, Cincinnati, Ohio.
- 1993 "Fertilization in flowering plants." Gordon Research Conference, Plymouth, New Hampshire.
- 1993 "Cytoskeletal organization within the embryo sac before and after fertilization in *Plumbago* and *Nicotiana*." XV International Botanical Congress, Yokohama, Japan.
- 1993 "Mitosis in the generative cell of tobacco (*Nicotiana tabacum*): Ultrastructural and three-dimensional organization. Oklahoma Microscopy Society/Oklahoma Academy of Science Annual Meeting, Ada, Oklahoma.
- 1993 "Endosymbiosis of the free-living alga *Chroomonas* in *Gymnodinium acidotum*: Quantification of endophyte modifications revealed by serial reconstruction." With S. D. Fields. Oklahoma Microscopy Society/Oklahoma Academy of Science Annual Meeting, Ada, Oklahoma.
- 1994 "Fertilization in higher plants." Ninth Annual Symposium on Plant Physiology. Pennsylvania State University, State College, Pennsylvania.
- 1994 "Gametes, cytoskeleton and fertilization in two flowering plant model systems." With B.-Q. Huang. XIII International Congress on Sexual Plant Reproduction, University of Vienna, Vienna, Austria.
- 1994 "Acquisition of chloroplasts through phagotrophy in the freshwater dinoflagellate *Gymnodinium acidotum*." With S. D. Fields. Oklahoma Microscopy Society/Oklahoma Academy of Science, Norman, Oklahoma.
- 1994 "Ultrastructural characterization of isolated sperm cells of the genus *Plumbago*." With G. W. Strout, D. Southworth, A. Reece and S. D. Fields. Oklahoma Microscopy Society/Oklahoma Academy of Science, Norman, Oklahoma.
- 1995 "Calcium distribution and accumulation in ovules and embryo sacs of *Nicotiana tabacum*." With H. G. Rian. Harnessing Apomixis: A New Frontier in Plant Science, Texas A & M University, College Station, TX, September 25-27, 1995.
- 1995 "Calcium distribution and accumulation in ovules and embryo sacs of the synergid-lacking angiosperm *Plumbago zeylanica*." With H. Zhu. Harnessing Apomixis: A New Frontier in Plant Science, Texas A & M University, College Station, TX, September 25-27, 1995.
- 1995 "Microscopy of the Internet: a tool for communication, education and research." Oklahoma Microscopy Society/Oklahoma Academy of Science Annual Meeting, Alva, Oklahoma, November 3, 1995.

- "Computer assisted three-dimensional portrayal of plant reproductive cell development." With A. K. Stramski. Oklahoma Academy of Sciences Annual Meeting. Alva, Oklahoma.
- 1987
- "Generative cell polarization in Plumbago zeylanica: development and morphogenesis". With G. W. Strout. Oklahoma Academy of Sciences/Oklahoma Society for Electron Microscopy. Alva, Oklahoma.
- 1988
- "Analysis and characterization of mature pollen protein and polypeptides of Plumbago." With N. R. Geltz. Botanical Society of America Annual Meetings. University of California, Davis, California.
- 1988
- "Isolation and characterization of isolated embryo sac and eggs of Plumbago." With B.-Q. Huang and G. W. Strout. Botanical Society of America Annual Meetings. University of California, Davis, California.
- 1988
- "Three-dimensional organization of generative cells during polarization and morphogenesis of Plumbago zeylanica." With A. K. Stramski and G. W. Strout. Botanical Society of America Annual Meetings, University of California, Davis, California.
- 1989
- "Generative cell polarization and formation of the male germ unit in Plumbago zeylanica". Laboratoire Reconnaissance Cellulaire et Amélioration des Plantes. Université Claude Bernard-Lyon 1, Villeurbanne Cedex, France.
- 1989
- "Characterization of the male gamete of the angiosperm Plumbago zeylanica". BAP meeting of European Economic Community, Université Claude Bernard-Lyon 1, Villeurbanne Cedex, France.
- 1989
- "Three-dimensional reconstruction in generative cell development and sperm organization: importance, methodology and results". Third meeting of the plant sperm cell club, Agricultural Research Institute, Hungarian Academy of Sciences, Martonvasar, Hungary.
- 1989
- "Gamete isolation in angiosperms." NATO Advances in Science Workshop; "Mechanism of Fertilization: Plants to Man." Hotel Tramontano, Sorrento, Italy.
- 1990
- "Isolation and characterization of gametes of Plumbago." With B.-Q. Huang. AIBS/BSA Annual Meetings. Richmond Center. Richmond, Virginia.
- 1990
- "Energy-dispersive x-ray microanalysis of cellular components in the pollen of an angiosperm, Plumbago zeylanica." XII International Congress for Electron Microscopy. Seattle, Washington.
- 1990
- "Cytoskeletal organization and modification in the process of fertilization of Plumbago zeylanica." With B.-Q. Huang. Oklahoma Academy of Science, Section K, Electron Microscopy, Tulsa.
- 1990
- "Sperm cells in the pollen tube of Nicotiana." With H.-S. Yu. Oklahoma Academy of Science, Section K, Electron Microscopy, Tulsa.
- 1991
- "Cytoskeleton organization and modification during fertilization in Plumbago zeylanica." With B.-Q. Huang. TSEM/Ok-SEM Joint Spring Workshop on 3-D imaging, Arlington, Texas.
- 1991
- "Origin of dimorphic sperm cells in the angiosperm Plumbago zeylanica." With G. W. Strout. TSEM/Ok-SEM Joint Spring Workshop on 3-D imaging, Arlington, Texas.
- 1991
- "Three dimensional reconstruction and quantitative cytology of the pollen of an orchid, Cymbidium goeringii." With H.-S. Yu. TSEM/Ok-SEM Joint Spring Workshop on 3-D Imaging, Arlington, Texas.
- 1991
- "Double fertilization in flowering plants." Developmental Biology Society of America, mini-symposium on "Sexual Reproduction in Plants," Marquette University, Milwaukee, Wisconsin.
- 1991
- "Video microscopy of organelle movement in growing pollen tubes and isolated embryo sacs." With E. S. Pierson, B.-Q. Huang, I. K. Lichtscheidl and M. Cresti. International Symposium on Angiosperm Pollen and Ovules. Basic and Applied Aspects. Villa Olmo, Como, Italy.
- 1991
- "Male cytoplasmic diminution in generative and sperm cells of flowering plants." With H.-S. Yu. American Institute of Biological Sciences/Botanical Society of American Annual Meetings, San Antonio, Texas.
- 1991
- "Fertilization in Nicotiana: synergid degeneration and cytoskeleton modification." With B.-Q. Huang. American Institute of Biological Sciences/Botanical Society of American Annual Meetings, San Antonio, Texas.
- 1991
- "Cytoskeleton organization and modification during fertilization in Nicotiana and Plumbago." with B.-Q. Huang. Oklahoma Academy of Science/Ok-SEM Fall Meeting, Durant, Oklahoma.
- 1991
- "Three-dimensional ultrastructure of generative cell mitosis in the pollen tubes of Nicotiana tabacum." with H.-S. Yu. Oklahoma Academy of Science/Ok-SEM Fall Meeting, Durant, Oklahoma.
- 1992
- "Generative cell mitosis in pollen tubes of Nicotiana tabacum: ultrastructure and three-dimensional reconstruction." With H.-S. Yu. 50th Annual Meeting of the Electron Microscopy Society of America, Boston, Massachusetts.
- 1992
- "Freeze-fracture observations of the sperm cells of Plumbago zeylanica in the pollen grain and after isolation." With G. W. Strout. American Institute of Biological Sciences/Botanical Society of America, Honolulu, Hawaii.
- 1992

- 1995 "Surface charge of *Plumbago* sperm cells estimated from microelectrophoretic mobility." With Z. Zhang. Oklahoma Microscopy Society/Oklahoma Academy of Science Annual Meeting, Alva, Oklahoma, November 3, 1995.
- 1995 "The observation of calcium-induced precipitations in *Plumbago zeylanica* ovule." With H. Zhu. Oklahoma Microscopy Society/Oklahoma Academy of Science Annual Meeting, Alva, Oklahoma, November 3, 1995.
- 1995 "Toward *in vitro* fertilization in *Plumbago zeylanica*." With Y. Cao. Oklahoma Microscopy Society/Oklahoma Academy of Science Annual Meeting, Alva, Oklahoma, November 3, 1995.
- 1996 "Sperm cell surface characteristics of flowering plants in relation to transport in the embryo sac." With Z. Zhang. American Society for Cell Biology, Annual Meetings, December 8-13, 1995, Washington, D. C.
- 1996 "Cell surface biology of male gametes of *Plumbago zeylanica*." 14th International Congress of Sexual Plant Reproduction, Lorne, Australia, February 18-23, 1996.
- 1996 "Structural considerations in angiosperm fertilization." Banbury Center Conference, Cold Spring Harbor Laboratory, NY, April 21-24, 1996.
- 1996 "Attraction and transport of male gametes for fertilization." 75th Birthday Symposium on Sexual Reproduction in Angiosperms for Professor Hans F. Linskens, Nijmegen, Netherlands, April 26-27, 1996.
- 1996 "Fertilization in flowering plants." Plant Developmental Genetics symposium, Federation of American Societies for Experimental Biology (FASEB), Summer Research Conference, August 10-15, 1996, Saxtons River, VT.
- 1997 "Sexual reproduction and fertilization in flowering plants." School of Botany, University of Porto, Porto, Portugal, May 20, 1997.
- 1997 "Attraction and transport of male gametes for fertilization." Botanical Society of America/Canadian Botanical Association Annual Meetings, Montreal, Quebec, Canada, August 3-7, 1997.
- 1997 "Construction and maintenance of Internet sites: rewards and drawbacks." Botanical Society of America/Canadian Botanical Association Annual Meetings, Montreal, Quebec, Canada, August 3-7, 1997.
- 1997 "Plant gametes and fertilization." With D. Southworth. Botanical Society of America/Canadian Botanical Association Annual Meetings, Montreal, Quebec, Canada, August 3-7, 1997.
- 1998 "Scanning electron microscopy study of isolated sperm cells of tobacco (*Nicotiana tabacum*)." With Z. Zhang. Oklahoma Microscopy Society/Oklahoma Academy of Science Annual Meeting, Chickasha, November 7, 1997.
- 1998 "Collection and characterization of male gametes of *Plumbago* and *Nicotiana*." With Z. Zhang and H-Q. Tian. Botanical Society of America Annual Meetings, Baltimore, Maryland, August 2-6, 1998.
- 1998 "Flowering plant sperm cell collection, fusion and transport." With Z. Zhang and H-Q. Tian. 15th International Congress on Sexual Plant Reproduction, Wageningen, Netherlands, August 16-21, 1998.
- 1998 "Immunolocalization of myosin on the surface of isolated sperm cells of tobacco (*Nicotiana tabacum*) and its relation to sperm cell transport." With Z. Zhang and H-Q. Tian. 15th International Congress on Sexual Plant Reproduction, Wageningen, Netherlands, August 16-21, 1998.
- 1998 "Biology of the angiosperm male gamete and its role in fertilization." International Symposium on Molecular and Biotechnical Aspects of Sexual Reproduction in Higher Plants (ICRO-UNESCO and FAO Symposium), Martonvasar, Hungary, August 23-25, 1998.
- 1998 "Comparison of hexamethyldisilazane and critical point drying on the surface structure of *Nicotiana tabacum* pollen tubes." With Z. Zhang. Oklahoma Microscopy Society/Oklahoma Academy of Science Annual Meeting, Tahlequah, November 14, 1998.
- 1998 "Freeze-substitution of *Brassica* anthers for preserving *Bra r* 1, a pollen allergenic protein." With Z. Zhang, T. Okada and K. Tonyama. Oklahoma Microscopy Society/Oklahoma Academy of Science Annual Meeting, Tahlequah, November 14, 1998.
- 1999 "Short-distance transport of sperm cells during fertilization in angiosperms." XVI International Botanical Congress, St. Louis, Missouri, USA, August 1-7, 1999.
- 1999 "Heterospermy during male germ unit maturation in *Nicotiana tabacum*." Development of gametes in flowering plants, D. Southworth and M.B. Singh, organizers. XVI International Botanical Congress, St. Louis, Missouri, USA, August 1-7, 1999, with Zhang, Z., and H.Q. Tian.
- 1999 "Heterospermy and preferential fertilization in tobacco." XVI International Botanical Congress, St. Louis, Missouri, USA, August 1-7, 1999, with Zhang, Z., and H.Q. Tian.
- 1999 "Ovule development." 3rd International EPS Conference. Catholic University, Nijmegen, The Netherlands, November 1-4, 1999.

- "Sperm-egg interactions." 3rd International EPS Conference. Catholic University, Nijmegen, The Netherlands, November 1-4, 1999.
- 2000 "Sperm collection and isolation for cDNA libraries." With Z. Zhang, H. Xu, I. Swoboda, P. Bhalla, M. B. Singh. XVI International Congress on Sexual Plant Reproduction, Banff Centre, Canada, April 1-5, 2000.
- 2000 "Interactivity on the Internet and interactive learning environments." Botanical Society of America Annual Meetings, Portland, Oregon, August 6-10, 2000.
- 2000 "Plumbago zeylanica sperm isolation, collection and cDNA library characterization." With Z. Zhang, H. Xu, I. Swoboda, P. Bhalla, M. B. Singh. Botanical Society of America Annual Meetings, Portland, Oregon, August 6-10, 2000.
- 2000 "Biology of angiosperm sperm cells." Frontiers in Sexual Plant Reproduction, Department of Biological Sciences, SUNY, Albany, New York, October 28-29, 2000.
- 2001 "Cell cycle, sperm dimorphism and sperm cell biology in flowering plants / Internet resources for botany". Texas Microscopy Society annual workshop, keynote speaker, Houston, TX, April 5, 2001.
- 2001 "Relationship between double fertilization and the cell cycle in male and female gametes of tobacco." With HQ Tian and T Yuan. Botany 2001 meeting of the Botanical Society of America, Albuquerque, NM, August 12-16, 2001.

INVITED PRESENTATIONS:

- 1980 "Male gametes and fertilization in angiosperms." With D. D. Cass. Botanical Society of America/Canadian Botanical Association Symposium: "Gametogenesis, Fertilization, and Embryo Development in Angiosperms." (Presented by D. D. Cass.)
- 1982 "Fertilization in Plumbago zeylanica: The structural basis of male cytoplasmic inheritance." Oklahoma State University, Stillwater, Oklahoma.
- 1983 "Fertilization in Plumbago zeylanica." University of Texas, Austin, Texas.
- 1984 "Timetable of fertilization in angiosperms." Pollination '84, International Symposium. University of Melbourne, Melbourne, Australia.
- 1984 "Gametic recognition in Plumbago and its implications in angiosperm reproduction. "VIII Symposium on the Embryogenesis of Ovulated Plants, Wageningen, The Netherlands.
- 1985 "Fertilization in Plumbago zeylanica and the concept of dimorphic sperm cells." University of California, Riverside, California.
- 1985 "Fertilization in angiosperms." University of California, Berkeley, California.
- 1985 "Dimorphic sperm cells, cytoplasmic transmission, and preferential fertilization in the synergid-less angiosperm, Plumbago zeylanica." The Chondriome, International Symposium, Wye College, University of London, Wye, Ashford, Kent, U.K.
- 1985 "Dimorphic sperm cells and preferential fertilization in Plumbago zeylanica." Agricultural University, Wageningen, Netherlands.
- 1987 "Fertilization in angiosperms and the concept of preferential fertilization." Auburn University, Auburn, Alabama.
- 1987 "Ultrastructure of fertilization". XIV International Botanical Congress, West Berlin, Federal Republic of Germany.
- 1987 "Polarization in the generative cell of Plumbago zeylanica". Second Conference on Flowering Plant Sperm Cells. Wageningen, Netherlands.
- 1988 "Dimorphic sperm cells and preferential fertilization in Plumbago". University of Georgia, Athens, Georgia.
- 1988 "Sperm cell isolation, characterization and dimorphism". Modern Advances in Flowering Plant Embryogenesis, Peking University, Beijing, P.R. China.
- 1988 "Development, polarization and morphogenesis of the generative cell of Plumbago zeylanica". Modern Advances in Flowering Plant Embryogenesis. Peking University, Beijing, P.R. China.
- 1988 "Techniques, rationales and procedures for conducting quantitative cytology and three-dimensional reconstruction". Modern Advances in Flowering Plant Embryogenesis, Peking University, Beijing, P.R. China.
- 1988 "Fertilization in angiosperms. Conceptual framework and evolutionary speculation". Modern Advances in Flowering Plant Embryogenesis, Peking University, Beijing, P. R. China.
- 1988

- "Generative cell morphogenesis and sperm formation in Plumbago zeylanica". Beijing Forestry University, Beijing, P.R. China.
- 1989 "Generative cell development and fertilization in Plumbago zeylanica". Universite Claude Bernard-Lyon 1, Villeurbanne Cedex, France.
- 1989 "Characterization of the male and female gametes of Plumbago zeylanica". Dipartimento di Biologie Ambientale, Universita di Siena, Siena, Italy.
- 1989 "Characterization of the male gamete of the angiosperm Plumbago zeylanica". BAP meeting of European Economic Community, Universite Claude Bernard-Lyon 1, Villeurbanne Cedex, France.
- 1989 "Biochemical and hybridoma antibody characterization of the male germ unit of Plumbago zeylanica". Université Claude Bernard-Lyon 1, Villeurbanne Cedex, France.
- 1989 "Fertilization in Populus deltoides: Implications for male cytoplasmic inheritance." Oklahoma Academy of Science, Keynote address, Section K, Electron Microscopy.
- 1989 "Gamete isolation in angiosperms." NATO Advances in Science Workshop; "Mechanisms of Fertilization Plants to Man." Hotel Tramontano, Sorrento, Italy.
- 1989 "New concepts in fertilization in flowering plants." Oklahoma State University. Stillwater, Oklahoma.
- 1990 "Fertilization in angiosperms." Department of Anatomical Sciences, OU Health Sciences Center, Oklahoma City, Oklahoma
- 1990 "Isolation and characterization of gametes of Plumbago." AIBS/BSA meeting, symposium "Plant Gametes and Fertilization." Richmond Center, Richmond, Virginia.
- 1991 "Synergid handedness, male cytoplasmic reduction and related topics." Oklahoma State University. Stillwater, Oklahoma.
- 1991 "Gamete isolation, characterization and fertilization in flowering plants." Division of Plant Biology, Samuel Roberts Noble Foundation, Ardmore, Oklahoma.
- 1991 "Female gamete and gametophyte organization and function in flowering plants." Plant Development minisymposium on "Plant Sexual Reproduction," Society for Developmental Biology, Marquette University, Milwaukee, Wisconsin.
- 1992 "Fertilization in flowering plants." Crop Sciences Society of America Meetings, Minneapolis, Minnesota.
- 1992 "Cytoskeletal organization within the embryo sac before and after fertilization in Nicotiana and Plumbago." With B.-Q. Huang. XII International Congress on Sexual Plant Reproduction, Columbus, Ohio.
- 1993 "Fertilization in angiosperms." IRBV & Department of Biology, University of Montreal, Quebec, Canada.
- 1993 "Fertilization in flowering plants." Department of Botany, University of Toronto, Toronto, Ontario, Canada.
- 1993 "Gametes, cytoskeleton and fertilization in angiosperms." Congress on Cell and Tissue Culture, San Diego, California.
- 1993 "Fertilization in flowering plants." Gordon Research Conference on "Fertilization." Plymouth, New Hampshire.
- 1993 "Cytoskeletal organization within the embryo sac before and after fertilization in Plumbago and Nicotiana." XV International Botanical Congress, Yokohama, Japan.
- 1994 "Fertilization in higher plants" Ninth Annual Symposium on Plant Physiology. Pennsylvania State University, State College, Pennsylvania.
- 1995 "Fertilization in flowering plants: New techniques and insights." Department of Botany, Oklahoma State University, Stillwater, Oklahoma.
- 1996 "Cell surface biology of male gametes of Plumbago zeylanica." 14th International Congress of Sexual Plant Reproduction, Lorne, Australia, February 18-23, 1996.
- 1996 "Emerging concepts in the study of sexual reproduction in angiosperms." Distinguished Visiting Lecturer series, University of Adelaide, Adelaide, Australia, February 27, 1996.
- 1996 "Structural considerations in angiosperm fertilization." Banbury Center Conference, Cold Spring Harbor Laboratory, NY, April 21-24, 1996.
- 1996 "Attraction and transport of male gametes for fertilization." 75th Birthday Symposium on Sexual Reproduction in Angiosperms for Professor Hans F. Linskens, Nijmegen, Netherlands, April 26-27, 1996.
- 1996 "Fertilization in flowering plants." Plant Developmental Genetics symposium, Federation of American Societies for Experimental Biology (FASEB), Summer Research Conference, August 10-15, 1996, Saxtons River, VT.
- 1997

- "Sexual reproduction and fertilization in flowering plants." School of Botany, University of Porto, Porto, Portugal, May 20, 1997.
- 1997 "Attraction and transport of male gametes for fertilization." Botanical Society of America/Canadian Botanical Association Annual Meetings, Montreal, Quebec, Canada, August 3-7, 1997.
- 1997 "Construction and maintenance of Internet sites: rewards and drawbacks." Botanical Society of America/Canadian Botanical Association Annual Meetings, Montreal, Quebec, Canada, August 3-7, 1997.
- 1997 "Calcium in pollen tube attraction, ovule fertility and synergid receptivity." Plant Molecular Biology and Biotechnology Group, Institute of Land and Food Resources, University of Melbourne, Parkville, Australia, October 15, 1997.
- 1997 "Generative cell formation, development and morphogenesis" Department of Agriculture and Resource Management, University of Melbourne, Parkville, Australia, November 12, 1997.
- 1997 "Fertilization in angiosperms." Department of Botany, Latrobe University, Bundoora, Melbourne, Australia, December 3, 1997.
- 1998 "Flowering plant sperm cell collection, fusion and transport." With Z. Zhang and H-Q. Tian. 15th International Congress on Sexual Plant Reproduction, Wageningen, Netherlands, August 16-21, 1998.
- 1998 "Biology of the angiosperm male gamete and its role in fertilization." International Symposium on Molecular and Biotechnical Aspects of Sexual Reproduction in Higher Plants (ICRO-UNESCO and FAO Symposium), Martonvasar, Hungary, August 23-25, 1998.
- 1999 "Short-distance transport of sperm cells during fertilization in angiosperms." XVI International Botanical Congress, St. Louis, Missouri, USA, August 1-7, 1999.
- 1999 "Heterospemy and preferential fertilization in tobacco." Development of gametes in flowering plants, D. Southworth and M.B. Singh, organizers. XVI International Botanical Congress, St. Louis, Missouri, USA, August 1-7, 1999, with Zhang, Z., and H.Q. Tian.
- 1999 "Fertilization in flowering plants." Department of Botany, Miami University, Oxford, Ohio, October 22, 1999.
- 1999 "Ovule development." 3rd International EPS Conference. Catholic University, Nijmegen, The Netherlands, November 1-4, 1999.
- 1999 "Sperm-egg interactions." 3rd International EPS Conference. Catholic University, Nijmegen, The Netherlands, November 1-4, 1999.
- 2000 "Interactivity on the Internet and interactive learning environments." Botanical Society of America Annual Meetings, Portland, Oregon, August 6-10, 2000.
- 2000 "Biology of angiosperm sperm cells." Frontiers in Sexual Plant Reproduction, Department of Biological Sciences, SUNY, Albany, New York, October 28-29, 2000.
- 2000 "Two topics: Sperm cell biology and Accessing Internet Resources in Biology". Department of Resource Management and Horticulture, University of Melbourne, Parkville, Victoria, Australia, November 29, 2000.
- 2000 "Cell cycle, sperm dimorphism and preferentiality in flowering plant fertilization." CSIRO Plant Industry Division, Canberra, Australia, December 1, 2000.
- 2001 "Cell cycle, sperm dimorphism and sperm cell biology in flowering plants / Internet resources for botany". Texas Microscopy Society annual workshop, keynote speaker, Houston, TX, April 5, 2001.
- 2001 "Relationship between double fertilization and the cell cycle in male and female gametes of tobacco" Department of Biological Sciences, University of Auckland, Auckland, New Zealand, December 5, 2001.

ABSTRACTS PUBLISHED:

1. Russell, S. D. and D. D. Cass. 1978. Post-fertilization development in Plumbago zeylanica. Botanical Society of America Abstracts. Allen Press, Lawrence, Kansas. Miscellaneous Series Publications 156:41.
2. Russell, S. D. 1979. Developmental modifications of sperm structure during pollen tube growth in Plumbago zeylanica. Botanical Society of America Abstracts. Allen Press, Lawrence, Kansas. Miscellaneous Publication Series 157:18.
3. Russell, S. D. 1980. Gamete delivery and syngamy in Plumbago zeylanica. Botanical Society of America/Canadian Botanical Association Abstracts. Allen Press, Lawrence, Kansas. Miscellaneous Series Publication 158:98-99.
4. Russell, S. D. 1981. Structure and quantitative cytology of male gametes of Plumbago zeylanica. XIII International Botanical Congress, Sydney, Australia, August 17-29. XIII International Botanical Congress Abstracts, pg. 61.
5. Russell, S. D. 1981. Gamete delivery and gamete fusion in the flowering plant Plumbago zeylanica. OK SEM Newsletter 5(1):10.
6. Russell, S. D. 1982. Quantitative cytology and stereology of male gametes and transmitted male cytoplasmic organelles in Plumbago zeylanica. Botanical Society of America Abstracts. Miscellaneous Series Publication 162:23.

77. Zhang, Z., Tian, H. Q and S. D. Russell. Heterospermy during male germ unit maturation in *Nicotiana tabacum*. Late Abstracts of the XVI International Botanical Congress, August 1-7, 1999, St. Louis, Missouri, USA, pg. 26
78. Russell, S.D., Z. Zhang, H. Xu, I. Swoboda, P. Bhalla and M. B. Singh 1999. Discrimination of flowering plant sperm cells using structural and molecular probes. OMS Bulletin 21(2): 19.
79. Russell, S.D., Z. Zhang, H. Xu, I. Swoboda, P. Bhalla and M. B. Singh. 2000. Sperm collection and isolation for cDNA libraries. Proceedings of the XVI International Congress on Sexual Plant Reproduction, Banff Centre, Canada, pg. 35
80. Russell, S.D. 2000. Interactivity on the Internet and interactive learning environments. Am. J. Bot. 87(6, suppl. 2): 186.
81. Russell, S.D., Z. Zhang, H. Xu, I. Swoboda, P. Bhalla and M. B. Singh. 2000. *Plumbago zeylanica* sperm isolation, collection and cDNA library characterization. Am. J. Bot. 87(6, suppl. 2): 31.
82. Russell, S.D. 2000. Biology of angiosperm sperm cells. Abstracts of Frontiers in Sexual Plant Reproduction, Department of Biological Sciences, SUNY, Albany, New York, October 29, 2000, pg. 30.
83. Russell, S.D., H.Q. Tian, T. Yuan and Z. Zhang. 2000. Coordinated cell cycle in male and female gametes of tobacco during double fertilization Oklahoma Microscopy Society Bulletin 22(2): 10.
84. Russell, S.D. 2001. Two Topics: Cell cycle, sperm dimorphism and sperm cell biology in flowering plants / Internet resources for botany. Proceedings of TSM Spring Meeting, Houston Marriott, Medical Center, Houston, TX, April 5-7, 2001
85. Tian, H.Q., T. Yuan and S.D. Russell. 2001. Relationship between double fertilization and the cell cycle in male and female gametes of tobacco. Proceedings of Botany 2001, Annual Meeting of the Botanical Society of America, Albuquerque, NM, August 12-16, 2001, pg 26.

RESEARCH FUNDING:

External:

- 1982-85 National Science Foundation. Division of Physiology, Cellular and Molecular Biology-Developmental Biology Program. "Investigations into sperm-specificity and transmission of male cytoplasmic organelles during early embryogenesis in the angiosperm *Plumbago zeylanica*". \$70,000.
- 1984-88 National Science Foundation. Division of Physiology, Cellular and Molecular Biology -Developmental Biology Program. "Generative cell formation, polarization and morphogenesis in *Plumbago zeylanica* as the developmental basis for sperm specificity." \$102,378.
- 1984 National Science Foundation. Biological Instrumentation Program. "Acquisition of a new scanning electron microscope." \$129,740. (not funded)
- 1985 National Science Foundation. Division of Physiology, Cellular and Molecular Biology-Developmental Biology Program. "Acquisition of eucentric goniometer for use with a Zeiss 10a transmission electron microscope." \$3,500 (supplemental grant)
- 1985 National Science Foundation. Division of Physiology, Cellular and Molecular Biology-Developmental Biology Program. "Gametogenesis, fertilization and early embryogenesis in *Drimys*: reproduction in a putatively primitive angiosperm." \$72,000 (supplemental grant).
- 1985 United States Department of Agriculture. Competitive Grants Program -Genetic Mechanisms. "Sexual reproduction in *Pisum* and *Phaseolus*: a comparison of gametic fusion mechanisms in flowering plants with differing patterns of male cytoplasmic inheritance." \$174,095. (not funded)
- 1986-88 United States Department of Agriculture. Competitive Grants Program Biotechnology/Plant Growth and Development Program. "Isolation and characterization of male and female gametes of the angiosperm *Plumbago zeylanica*." \$91,000
- 1986 State of Oklahoma - MOST Program. "Acquisition of Analytical Electron Microscopy Equipment. " \$150,000.
- 1986 State of Oklahoma - MOST Program. "Acquisition of a Quantitative Electron Microprobe." \$250,000. Funding redirected to purchase analytical electron microscopy equipment.
- 1986 Department of Energy-Coal Research Program. "Acquisition of a Quantitative Electron Microprobe." (with D. London) \$620,000.
- 1986 Department of Education. "Acquisition of Analytical Electron Microscopy Equipment and Creation of an Electron Microprobe Facility." \$500,000.
- 1987 State of Oklahoma - MOST Program, "Matching Funds for Energy-Dispersive X-Ray Analysis System." \$100,000.
- 1987-88 University of Pennsylvania. "Ultrastructural Effects of Acid Rain on the Needles of Red Spruce, *Picea rubens*". (billable contract)
- 1987 National Science Foundation. Developmental Biology Program. "Supplemental Award to Involve Undergraduates in Studies of Sperm Organization in *Plumbago zeylanica*". \$4,000 (supplemental grant).
- 1988-91 United States Department of Agriculture. Competitive Grants Program. Molecular and Cellular Mechanisms of Plant Growth and Development. "Isolation and characterization of male and female gametes of the angiosperm *Plumbago zeylanica*." \$150,000.

43. Huang, B.-Q. and S. D. Russell. 1992. Cytoskeletal organization within the embryo sac before and after fertilization in *Nicotiana*. Annual Meeting of Oklahoma Academy of Science/Oklahoma Society for Electron Microscopy, Lawton, Oklahoma. OkSEM Newsletter 14(2):14.
44. Yu, H.-S. and S. D. Russell. 1992. Mitochondria entrapped within the sperm nucleus of *Nicotiana tabacum*. Annual meeting of Oklahoma Academy of Science/Oklahoma Society for Electron Microscopy, Lawton, Oklahoma. OkSEM Newsletter 14(2):13.
45. Yu, H.-S. and S. D. Russell. 1992. Occurrence of mitochondria inside the sperm nucleus of tobacco. Annual Meeting of American Society of Cell Biology, Denver, Colorado. Molecular Biology of the Cell 3 (Suppl.): 1066.
46. Russell, S. D. 1993. Gametes, cytoskeleton and fertilization in angiosperms. Congress on Cell and Tissue Culture, San Diego, California. In Vitro Cellular and Developmental Biology, pg. 17.
47. Russell, S. D. 1993. Cytoskeletal organization within the embryo sac before and after fertilization in *Plumbago* and *Nicotiana*. XV International Botanical Congress, Yokohama, Japan, pg. 97.
48. Yu, H.-S. and S. D. Russell. 1993. Ultrastructure and three-dimensional organization of mitosis in generative cells of *Nicotiana tabacum*. Annual meeting of Botanical Society of America/Canadian Botanical Association, Ames, Iowa. American Journal of Botany 80 (6, supplement): 39-40.
49. Fields, S. D. and S. D. Russell. 1993. Endosymbiosis of the free-living alga *Chroomonas* in *Gymnodinium acidotum*: Quantification of endophyte modifications revealed by serial reconstruction. Oklahoma Microscopy Society/Oklahoma Academy of Science Annual Meeting, Ada, Oklahoma. OMS Newsletter 15 (2): 12.
50. Russell, S. D. and H.-S. Yu. 1993. Mitosis in the generative cell of tobacco (*Nicotiana tabacum*): ultrastructural and three-dimensional organization. Oklahoma Microscopy Society/Oklahoma Academy of Science Annual Meeting, Ada, Oklahoma. OMS Newsletter 15 (2): 14.
51. Russell, S. D. and B.-Q. Huang. 1994. Gametes, cytoskeleton and fertilization in two flowering plant model systems. Abstracts of the XIII International Congress on Sexual Plant Reproduction, University of Vienna, Vienna, Austria, p. 22.
52. Fields, S. D. and S. D. Russell. 1994. Acquisition of chloroplasts through phagotrophy in the freshwater dinoflagellate *Gymnodinium acidotum*. OMS Bulletin 16 (2):11.
53. Strout, G. W., D. Southworth, A. Reece, S. D. Fields and S. D. Russell. 1994. Ultrastructural characterization of isolated sperm cells of the genus *Plumbago*. OMS Bulletin 16 (2): 14.
54. Cao, Y. and S. D. Russell. 1995. Toward *in vitro* fertilization in *Plumbago zeylanica*. OMS Bulletin 17 (2):13.
55. Russell, S. D. 1995. Microscopy on the Internet: a tool for communication, education and research. OMS Bulletin 17(2):17.
56. Tian, H. Q. and S. D. Russell. 1995. Calcium distribution and accumulation in ovules and embryo sacs of *Nicotiana tabacum*. Harnessing Apomixis: A New Frontier in Plant Science, Texas A & M University, College Station, TX, September 25-27, pg. 77.
57. Zhang, Z. and S. D. Russell. 1995. Sperm cell surface characteristics of flowering plants in relation to transport in the embryo sac. American Society for Cell Biology, Annual Meetings, December 8-13, 1995, Washington, D. C., pg.
58. Zhang, Z. and S. D. Russell. 1995. Surface charge of *Plumbago* sperm cells estimated from microelectrophoretic mobility. OMS Bulletin 17 (2):14.
59. Zhu, H. and S. D. Russell. 1995. The observation of calcium-induced precipitation in *Plumbago zeylanica* ovule. OMS Bulletin 17 (2):14.
60. Zhu, H. and S. D. Russell. 1995. Calcium distribution and accumulation in ovules and embryo sacs of the synergid-lacking angiosperm *Plumbago zeylanica*. Harnessing Apomixis: A New Frontier in Plant Science, Texas A & M University, College Station, TX, September 25-27, pg. 38.
61. Cao, Y. and S. D. Russell. 1996. PEG-induced fusion between isolated eggs in *Plumbago zeylanica*. OMS Bulletin 18 (2): 14.
62. Russell, S. D., and H. Q. Tian. 1996. Basis of antimonate precipitation to detect loosely-bound calcium and its relationship to sexual reproduction in tobacco, *Nicotiana tabacum*. OMS Bulletin 18 (2): 14.
63. Southworth, D., G. W. Strout, and S. D. Russell. 1996. Freeze fracture of *Plumbago* sperm. Proceedings of the XIV International Congress of Sexual Plant Reproduction, University of Melbourne, Melbourne, Australia, pg. 49.
64. Zhang, Z., G. W. Strout, H. Zhu, and S. D. Russell. 1996. Cell surface biology of male gametes of *Plumbago zeylanica*. Proceedings of the XIV International Congress of Sexual Plant Reproduction, University of Melbourne, Melbourne, Australia, pg. 42.
65. Russell, S. D. 1997. Attraction and transport of male gametes for fertilization. American Journal of Botany 84 (6, suppl.): 33.
66. Russell, S. D. 1997. Construction and maintenance of Internet sites: rewards and drawbacks. American Journal of Botany 84 (6, suppl.): 256.
67. Southworth, D. and S. D. Russell. 1997. Plant gametes and fertilization. American Journal of Botany 84 (6, suppl.): 33.
68. Zhang, Z. and S. D. Russell. 1997. Scanning electron microscopy study of isolated sperm cells of tobacco (*Nicotiana tabacum*). OMS Newsletter 19(2): 18.
69. Mattison, S. and S. D. Russell. 1998. Comparison of hexamethyldisilazane and critical point drying on the surface structure of *Nicotiana tabacum* pollen tubes. OMS Newsletter 20(2): 22.
70. Russell, S. D., Z. Zhang and H.-Q. Tian. 1998. Collection and characterization of male gametes of *Plumbago* and *Nicotiana*. American Journal of Botany 85(6, suppl.): 18.
71. Russell, S. D., Z. Zhang, M.B. Singh, H. Xu, I. Swoboda, and P. Bhalla. 1998. Relearning how to do microscopy in a molecular lab in Australia. OMS Newsletter 20(2): 23.
72. Zhang, Z., T. Okada, K. Toriyama and S. D. Russell. 1998. Freeze-substitution of *Brassica* anthers for preserving *Bra r* I, a pollen allergenic protein. OMS Newsletter 20(2): 20.
73. Zhang, Z., H.-Q. Tian, and S. D. Russell. 1998. Immunolocalization of myosin on the surface of isolated sperm cells of tobacco (*Nicotiana tabacum*) and its relation to sperm cell transport. Proceedings of the 15th International Congress on Sexual Plant Reproduction, Wageningen, Netherlands, pg. 118.
74. Zhang, Z., H.-Q. Tian and S. D. Russell. 1998. Flowering plant sperm cell collection, fusion and transport. Proceedings of the 15th International Congress on Sexual Plant Reproduction, Wageningen, Netherlands, pg. 46.
75. Russell, S. D. 1999. Short-distance transport of sperm cells during fertilization in angiosperms. Abstracts of the XVI International Botanical Congress, August 1-7, 1999, St. Louis, Missouri, USA, pg. 103.
76. Zhang, Z., Tian, H. Q. and S. D. Russell. Heterospermy and preferential fertilization in tobacco. Abstracts of the XVI International Botanical Congress, August 1-7, 1999, St. Louis, Missouri, USA, pg. 566.

7. Russell, S. D. 1983. Gametic fusion in Plumbago zeylanica: ultrastructural evidence for gamete recognition and the preferential transmission of sperm plastids into the zygote. Botanical Society of America/Canadian Botanical Association Abstracts. Amer. J. Bot. 70(5, pt. 2): 31.
8. Russell, S. D. 1984. Evidence for gametic recognition in the angiosperm Plumbago zeylanica. Ok-SEM Newsletter 6(1):12.
9. Russell, S. D. 1984. Gametic recognition and its implications in angiosperm reproduction. VIII Symposium on the Embryogenesis of Ovulated Plants, Wageningen, The Netherlands, pg. 46.
10. Russell, S. D. 1984. Three-dimensional reconstruction in the study of the male gamete of flowering plant. Ok-SEM Newsletter 6(2):7.
11. Russell, S. D. 1985. Microgametogenesis in Plumbago zeylanica. Amer. J. Bot. 72 (6): 830-831.
12. Russell, S.D. 1985. Biphasic pollen tube growth in Plumbago zeylanica. In: Biotechnology and Ecology of Pollen Symposium, Amherst, Massachusetts.
13. Russell, S. D. 1985. Dimorphic sperm cells, cytoplasmic transmission, and preferential in the synergid-less angiosperm, Plumbago zeylanica. In: The Chondriome Second International Symposium, Wye College, University of London, Wye, U.K.
14. Russell, S. D. 1985. Isolation of sperm cells in Plumbago zeylanica. In: The Chondriome Second International Symposium, Wye College, University of London, Wye, U.K.
15. Russell, S. D. 1987. Sperm dimorphism and preferential gametic fusion in Plumbago zeylanica. In: Proceedings of the XIV International Botanical Congress.
16. Stramski, A. K., and S. D. Russell. 1987. Computer-assisted three-dimensional portrayal of plant reproductive cell development. Ok-SEM Newsletter 9(2):9.
17. Strout, G. W., and S. D. Russell. 1987. Generative cell polarization in Plumbago zeylanica: development and morphogenesis. Ok-SEM Newsletter 9(2):9.
18. Geltz, N. R. and S. D. Russell. 1988. Analysis and characterization of mature pollen protein and polypeptides of Plumbago. Amer. J. Bot. 75(6):28.
19. Huang, B.-Q., G. W. Strout, and S. D. Russell. 1988. Isolation and characterization of isolated embryo sacs and eggs of Plumbago. Amer. J. Bot. 75(6):33-34.
20. Russell, S. D., A. K. Stramski, and G. W. Strout. 1988. Three-dimensional organization of generative cells during polarization and morphogenesis of Plumbago zeylanica. Amer. J. Bot. 75(6):44.
21. Russell, S. D., and L. J. Mao. 1989. Relationships in sporophytic-gametophytic symmetry in Linum usitatissimum. Amer. J. Bot. 76(6):55.
22. Russell, S.D., M. Rougier, and C. Dumas. 1989. Fertilization in Populus deltoides: Implications for male cytoplasmic inheritance. Ok-SEM Newsletter 11: 20.
23. Russell, S. D. and B. Q. Huang. 1990. Isolation and characterization of gametes of Plumbago. Amer. J. Bot. 77(6):7.
24. Huang, B.-Q. and S. D. Russell. 1990. Cytoskeletal organization and modification in the process of fertilization of Plumbago zeylanica. Ok-SEM Newsletter 12(2):17.
25. Yu, H.-S. and S.D. Russell. 1990. Sperm cells in the pollen tube of Nicotiana. Ok-SEM Newsletter 12(2):17.
26. Russell, S. D. and H.-S. Yu. 1991. Male cytoplasmic diminution in generative & sperm cells of flowering plants. American Journal of Botany 78 (6, suppl.): 26.
27. Huang, B.-Q., and S. D. Russell. 1991. Fertilization in Nicotiana: synergid degeneration and cytoskeleton modification. American Journal of Botany 78 (6, suppl.): 34.
28. Huang, B.-Q., and S. D. Russell. 1991. Cytoskeletal organization and modification during fertilization in Plumbago zeylanica. TSEM Bulletin, Ok-SEM Bulletin 13(1) 31.
29. Yu, H.-S. and S. D. Russell. 1991. Three-dimensional reconstruction and quantitative cytology of the pollen of an orchid, Cymbidium goeringii. TSEM Bulletin, Ok-SEM Bulletin 13(1): 28.
30. Russell, S. D. and G. W. Strout. 1991. Origin of dimorphic sperm cells in the antiosperm Plumbago zeylanica. TSEM Bulletin, Ok-SEM Bulletin 13(1):29.
31. Pierson, E. S., B.-Q. Huang, I. K. Lichtscheidl, S. D. Russell and M. Cresti. 1991. Video microscopy of organelle movement in growing pollen tubes and isolated embryo sacs. International symposium on angiosperm pollen and ovules. Basic and applied aspects, Villa Olmo, Como, Italy. pg. 50.
32. Huang, B.-Q. and S. D. Russell. 1991. Cytoskeletal organization and modification during fertilization in Nicotiana and Plumbago. Ok-SEM Bulletin 13(2):39.
33. Yu, H.-S. and S. D. Russell. 1991. Three-dimensional ultrastructure of generative cell mitosis in the pollen tubes of Nicotiana tabacum. Ok-SEM Bulletin 13(2):36.
34. Russell, S. D. and G. W. Strout. 1992. Freeze-fracture observations of the sperm cells of Plumbago zeylanica in the pollen grain and after isolation. American Journal of Botany (6, supplement): 116.
35. Huang, B.-Q. and S. D. Russell. 1992. Synergid degeneration in Nicotiana: a light, transmission and scanning electron microscope study. Abstracts of XII International Congress on Sexual Plant Reproduction, pg. 29.
36. Huang, B.-Q., G. W. Strout and S. D. Russell. 1992. The ultrastructural organization of freeze-substituted ovules of Nicotiana tabacum before and after fertilization. Abstracts of XII International Congress on Sexual Plant Reproduction, pp. 29-30.
37. Russell, S. D. and B.-Q. Huang. 1992. Cytoskeletal organization within the embryo sac before and after fertilization in Nicotiana and Plumbago. Abstracts of XII International Congress on Sexual Plant Reproduction. pg. 58.
38. Yu, H.-S. and S. D. Russell. 1992. Computer-assisted three dimensional reconstruction of generative cell mitosis in pollen tubes of Nicotiana. Abstracts of XII International Congress on Sexual Plant Reproduction, pg. 80.
39. Yu, H.-S. and S. D. Russell. 1992. Three-dimensional reconstruction and quantitative cytology in pollen of Cymbidium goeringii. Abstracts of XII International Congress on Sexual Plant Reproduction, pg. 79.
40. Yu, H.-S., B.-Q. Huang and S. D. Russell. 1992. Male cytoplasmic transmission during fertilization in Nicotiana. Abstracts of XII International Congress on Sexual Plant Reproduction, pg. 79.
41. Russell, S. D. 1992. Fertilization in flowering plants. Abstracts of Crop Sciences Society of America Meetings, Minneapolis, Minnesota, pg. 309.
42. Fields, S. D., G. W. Strout and S. D. Russell. 1992. Development of a spray freezing apparatus for the rapid cryofixation of a fragile, unicellular alga. Annual Meeting of Oklahoma Academy of Science/Oklahoma Society for Electron Microscopy, Lawton, Oklahoma. OkSEM Newsletter 14(2):12.

- National Science Foundation. Directorate for Biological Instrumentation and Resources, Multi-User Biological Equipment and Instrument Resources Program. "Acquisition of a confocal laser scanning microscope" \$106,281 proposed (total cost of proposal: \$212,562) (Denied)
- 1995-98 National Aeronautics and Space Administration. "Sexual reproduction of flowering plants in microgravity" \$239,593 (not funded)
- 1995-98 United States Department of Agriculture. National Research Initiative Competitive Grants Program - Plant Growth and Development. "Gamete interactions during fertilization in angiosperms." \$95,888 (NRICRP grant #95-37304-2361)
- 1997-98 University of Melbourne, Senior Researcher Travel Grants Scheme (with Prof. M. Singh). "Characterization of genes of the generative cell of *Lilium*". A\$6,000
- 1998-99 University of Melbourne, Senior Researcher Collaborative Research Grants Scheme (with Prof. M. Singh). "Characterization of gene expression of sperm cells of *Plumbago zeylanica*". A\$10,000
- 1997-99 Praxis XXI, JNICT, Lisboa, Portugal. "Biologia da reprodução em *Amaranthus* de grão (*Amaranthus hypochondriacus* L.) cecamismos de atracção e diccionamento do tubo polínico." 6,750,000 Escudos (submitted by Prof. Roberto Salema, Universidad da Porto) as proposed funded collaborator (denied funding)
- 1997-99 United States Department of Agriculture. National Research Initiative Competitive Grants Program - Plant Growth and Development. "Gamete interactions during fertilization in angiosperms." \$100,000 (NRICRP grant #95-37304-2361)
- 1999-2002 United States Department of Agriculture. National Research Initiative Competitive Grants Program - Plant Growth and Development. "Flowering plant fertilization: attraction, interaction & transport of gametes" \$150,000 (NRICRP grant #99-35304-8097).
- 2000-2003 National Science Foundation. Directorate for Integrative and Neurobiology. Plant and Microbial Developmental Mechanisms Program. "Sperm-expressed genes in the flowering plant *Plumbago zeylanica*" \$834,807 (denied).
- 2000-2003 United States Department of Agriculture. National Research Initiative Competitive Grants Program - Plant Growth and Development. "Flowering plant fertilization: Interaction and biology of gametes" \$335,888 (denied).
- 2000-2003 National Science Foundation. Major Instrumentation Program. "Acquisition of multiuser confocal fluorescence microscope" \$217,000 (denied) total project \$308,000.

Internal Funding:

- 1981 Arts and Sciences Summer Fellowship. "Relationship of Sperm Cytoplasmic Organelles and Destiny of Male Gametes During Gamete Fusion in *Plumbago zeylanica*." \$3500.
- 1982 Research Council. "Purchase of a diamond knife to support studies into sperm-specificity in the angiosperm *Plumbago zeylanica*". \$2280.
- 1983 Research Council. Purchase of fluorescence microscope attachments for investigating the cell surface of flowering plant gametes." \$4830.
- 1984 Research Council "Examination of the developmental basis of sperm-specificity in the male gamete of a flowering plant." \$4100.
- 1985 Research Council "Acquisition of micromanipulator to isolate the egg of a flowering plant for *in vitro* fertilization." \$1150.
- 1985 OU Associates Research/Creative Activity Fund "Equipment for quantitative fluorescence microscopy." \$30,000 (with P.B. Bell, J. N. Farmer, H. Haines, J. Murphy and T. Yoshino).
- 1986 Research Council "Protein characterization equipment for studies on fertilization in flowering plants". \$5,000.
- 1987 OU Associates Research/Creative Activity Fund "An ultrarapid propane jet freezing device". \$9,800 (with L. A. Pfister, J. S. Fletcher, B. M. Fung and W. Ortiz-Leduc).
- 1987 OU Interdisciplinary Research Support Fund "Technical and operations support for interdisciplinary electron microscopic research". \$51,000. (not funded)
- 1988 Career Development Grant "Training for new electron microscopy equipment". \$5,000.
- 1988 Biomedical Research Support Grant "Research support for electron microscopy work". \$16,055
- 1989 Biomedical Research Support Grant "Acquisition of cryo-pumped freeze-fracture device". \$12,500
- 1990 Personal Computer Proposal, Merrick Computer Center "Three-dimensional reconstruction facility for electron microscopy." \$6,502
- 1991

1988-90 University of Pennsylvania. "Ultrastructural effects of acid rain on the needles of red spruce, *Picea rubens*." \$10,000

1990-92 National Science Foundation. Cell Biology Program. "Biochemical and physiological characterization of the male gamete of a cytoplasmically heterospermic angiosperm". \$278,976 (denied).

1990-92 Department of Energy. Biological Energy Program. "Biochemical and physiological characterization of the male gamete of a cytoplasmically heterospermic angiosperm." \$278,976 (denied).

1990-91 North Atlantic Treaty Organization. Grants for International Collaboration in Research. "Characterization of cytoskeleton of flowering plant gametes during development and fertilization." BF 200,000 (approx. \$5,150).

1990-91 Italian Ministry of Research, Rome, Italy. Support for visiting post doctoral research associate for six months. 15,800,000 lire (approx. \$13,000).

1990 National Science Foundation. Division of Cellular Biosciences. Development Biology Program. "Symposium: 'Plant gametes and fertilization' at the American Institute of Biological Sciences meeting in Richmond, VA, August, 1990." \$5,000 (Co-PI, Darlene Southworth).

1990 Pioneer HiBreds International. "Symposium: 'Plant gametes and fertilization' at the American Institute of Biological Sciences meeting in Richmond, VA, August, 1990." \$1,500.

1990 Botanical Society of America. "Symposium: 'Plant gametes and fertilization' at the American Institute of Biological Sciences meeting in Richmond, VA, August, 1990." \$1,000.

1990-92 National Science Foundation. Division of Cellular Biosciences. Instrumentation and Instrument Development Program. "Acquisition of a Confocal Scanning Laser Microscope for Biological Research." \$150,926 (total, denied) (co-PIs Paul B. Bell, Jr., Joseph A. Bastian, Ming-Chen Liu, Lois Pfister and Brian R. Waldrop).

1990-91 Kerr-McGee. "Materials research using electron microscopic methods." (billable contract) (co-PI Bill Chisoe).

1990-91 Support Services Engineering Corporation. "Materials fracture and corrosion deposit research." (billable contract)

1990-93 Oklahoma Center for the Advancement of Science and Technology. Applied Research Program, "Development of *in vitro* fertilization in an angiosperm." \$135,984 (denied funding).

1990-92 Samuel Roberts Noble Foundation, Ardmore. "Research on elemental distribution in plant tissues using electron microscopy." (cooperative agreement)

1991-92 North Atlantic Treaty Organization. Grants for International Collaboration in Research. "Characterization of cytoskeleton of flowering plant gametes during development and fertilization." BF 200,000 (. approx. \$7,000). (denied funding)

1991-92 Hitachi Computer Corporation, Norman. "Analysis of magnetic heads of hard disks using electron microscopy." (cooperative agreement)

1991-92 National Science Foundation. Division of Cellular Biosciences. Instrumentation and Instrument Development Program. Acquisition of a confocal scanning microscope for multi-disciplinary studies." (With P. B. Bell, Jr., Joseph A. Bastian, Paul S. Begovac, Ming-Cheh Liu, Lois Pfister and John Waldrop) \$113,540 ([matching funds] total project: \$222,910, denied)

1991-96 United States Department of Agriculture. National Research Initiative Competitive Grants Program—Plant Growth and Development Program. "Cytoskeleton during fertilization in flowering plants." #91-37304-6471

1992-95 United States Department of Education. Graduate Assistance in Areas of National Need (GAANN) Program. Approx. \$400,000 (on writing committee, not a direct participant). (denied)

1992-93 CONOCO Inc., Ponca City. "Electron microscopic analysis of physical sciences specimens." (cooperative agreement)

1992-94 National Science Foundation, Developmental Biology Program. "Ultrastructural organization of the mitotic apparatus in the bicellular pollen of *Nicotiana tabacum*." \$173,374 (denied)

1993-94 Samuel Roberts Noble Foundation, Ardmore. "Research on elemental distribution in plant tissues using electron microscopy." (cooperative agreement)

1993-94 Look Incorporated, Ada. "Evaluation of surgical needles and improvements in preparation of surfaces." (cooperative agreement)

1993-95 National Science Foundation. Systematic Biology Program. "Molecular and ultrastructural adaptations characterizing the transient symbiosis between *Glenodiniopsis acidotum* and *Chroomonas* sp." \$5,300 (With S. Fields) NSF grant #DEB-9311481

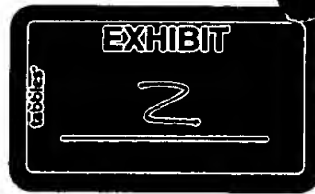
1994-97 National Science Foundation. Directorate for Integrative and Neurobiology. Developmental Mechanisms Program. "Gamete interactions in flowering plants" \$285,548 proposed. (Denied)

1994-96

- Research Council. "Acquisition of preparation equipment for physical sciences transmission electron microscopy". (co-
PIs: G. Atkinson, T. Batchman, R. Daniels and D. London) \$7,500 (matching funds: \$5,760; total project: \$13,260).
- 1991 OU Research Council. "Acquisition of metal mirror contact-freezing device" (with L. Beavers, M-C. Liu) \$6,700.
- 1995 OU Research Council. "Purchase of osmometer to support studies into in vitro fertilization in flowering plants" \$4,341.
- 1996 Vice President for Research. "Upgrade existing energy-dispersive x-ray analysis system for scanning electron
microscopy" \$18,000 (Total project cost: \$22,500)
- 1996 Research Council. "LaserTweezers to support research on in vitro fertilization in angiosperms." \$10,000 (Total project
cost: \$11,500) (denied)
- 1998 Travel support for airfare to Australia sought and received from Vice President for Research, Dean of College of Arts
and Sciences and Department. (Total: \$1,650)
- 1999 Vice President for Research. "Upgrade existing energy-dispersive x-ray analysis system for transmission electron
microscopy" \$22,000 (Total project cost: \$29,500)
- Instructional Funding - Internal:
- 1993 Instructional Resources Program. "Acquisition of Video Microscopy Equipment for Botany Courses." \$8,500 (with G. E.
Uno)
- 1994 Instructional Resources Program. "Facilities enhancements for General Botany laboratories" \$13,000 (with G.E. Uno)

OSWEGO

STATE UNIVERSITY OF NEW YORK



#9
2/4

To: Don Smith

3 Sep 2002

Re: Support of Patent Application: Methods and Mixtures for Treating Distressed Trees

I am an expert on the development and structure of roots of vascular plants, especially flowering plants. The application referred to deals with the effects of growth regulators and required mineral elements of plant growth, as applied through holes *in situ* on the recovery of flowering plant (hardwood) trees like post oaks from various environmental stresses.

The application of a root growth regulator (hormone) in combination with a fertilizer mixture via some kind of spray implement in a hole(s) during *in situ* application represents a significant difference from the patented Mehra-Palta method because the Smith method would necessarily be a different mixture of hormones and minerals since they would be applied to hardwood (flowering plant) roots, not conifers. This is very important because there are small but very important differences between the ectomycorrhizal associations of the conifers (pines, etc.), which Mehra-Palta specifically used in his patented procedure, and the post oaks for which Smith's procedure is designed. These association differences most likely have profound effects upon the growth and meristems of the post oaks that are not typical of the conifers; in addition, the root meristems themselves are quite different in post oaks and would be differently affected by the procedures. I must tell the reviewer that it is not just a reactivation to effect lateral or adventitious rooting that is important here (referred to in some ways by the Green light Rootone and Dale systems and to a very different degree in the Mehra-Palta system), but it is an effect upon already existing meristems and their derived tissues, as well as lateral and even adventitious roots.

Moreover, the Dale and Green Light Rootone procedures, referred to by Jeffrey L. Green, represent different combinations (hormones/minerals) and treatment methods than Smith's application. It is further clear from reading Mehra-Palta, Dale, and Green Light Rootone that those applications had not, in fact, envisioned Smith's method of application and way of use of the plant growth hormones and mineral elements, nor could one reasonably be expected to extend their procedures to the Smith plan and uses. If anything, I cannot understand how Mehra-Palta received a patent on a culture procedure that had been well documented by others for longer than 30 years before his application, and these were different from the Smith application.

Sincerely,

James L. Seago, Jr., Ph.D.

Department of Biology

SUNY, College at Oswego, New York 13126

Email: seago@oswego.edu

RECEIVED
OCT 11 2002
GROUP 3600

Curriculum Vitae of JAMES L. SEAGO, JR.

Department of Biology
SUNY at Oswego
Oswego, NY 13126
Phone: 315/312-2777
Email: seago@oswego.edu
FAX: 315-312-3059

P. O. Box 316
Minetto, NY 13115
Phone: 315/343-9523

Education

B.A. 1963. Knox College (Biology), Galesburg, IL.
M.A. 1966. Miami University (Botany), Oxford, OH.
Ph.D. 1969. University of Illinois (Botany), Urbana, IL.

Professional Positions

Assistant Professor of Biology, 1968-1975, SUNY at Oswego.
Associate Professor of Biology, 1975-1991, SUNY at Oswego.
Professor of Biology, 1991-, SUNY at Oswego.
Chair, Department of Biology, 1979-1985, SUNY, College at Oswego.
Adjunct Faculty, SUNY at Plattsburgh, *In Vitro* Cell Biology & Biotechnology, 1990-92.
Editorial Board Member, Environmental & Experimental Botany, 1992-.
Program Director, Developmental & Structural Section, Botanical Society of America, 1994-97.

Research Publications

Payne, W.W., and J.L. Seago. 1968. The open conduplicate carpel of *Akebia quinata* (Berberidales: Lardizabalaceae). Amer. J. Bot. 55: 575-581.

Seago, J.L., and C. Heimsch. 1969. Apical organization in roots of the Convolvulaceae. Amer. J. Bot. 56: 131-138.

Seago, J.L. 1971. Developmental anatomy in roots of *Ipomoea purpurea*. I. Radicle and primary root. Amer. J. Bot. 58: 604-615.

Seago, J.L. 1973. Developmental anatomy in roots of *Ipomoea purpurea*. II. Initiation and development of secondary roots. Amer. J. Bot. 60: 607-618.

Seago, J.L., and S.M. Wolniak. 1976. Cortical ontogeny in roots. I. *Zea mays*. Amer. J. Bot. 63: 220-225.

Kausch, A.P., J.L. Seago, Jr., and L.C. Marsh. 1981. Changes in starch distribution in the overwintering organs of *Typha latifolia* (Typhaceae). Amer. J. Bot. 68: 877-880.

Seago, J.L., Jr., and L.C. Marsh. 1989. Adventitious root development in *Typha glauca*, with emphasis on the cortex. Amer. J. Bot. 76: 909-923.

Seago, J.L., Jr., and L.C. Marsh. 1990. Origin and development of lateral roots in *Typha glauca*. Amer. J. Bot. 77: 713-721.

Seago, J.L., Jr., C.A. Peterson, and D.E. Enstone. 1999. Cortical ontogeny in roots of the aquatic plant, *Hydrocharis morsus-ranae* L. Can. J. Bot. 77: 113-121.

Seago, J.L., Jr., C.A. Peterson, D.E. Enstone, and C.A. Scholey. 1999. Development of the endodermis and hypodermis of *Typha glauca* Godr. and *T. angustifolia* roots. Can J. Bot. 77: 122-134.

Seago, J.L., Jr., C.A. Peterson, and D.E. Enstone. 2000. Cortical development in roots of the aquatic plant, *Pontederia cordata* L. Amer. J. Bot. 87: 1116-1127.

Seago, J.L., Jr., C.A. Peterson, L.J. Kinsley, and J. Broderick. 2000. Development and structure of the root cortex in *Caltha palustris* L. and *Nymphaea odorata* Ait. Ann. Bot. 85: 631-640.

Seago, J.L., Jr. 2002. The root cortex in the Nymphaeaceae, Cabombaceae, and Nelumbonaceae. J. Torrey Bot. Soc. 129: 1-9.

McManus, H.A., J.L. Seago, Jr., and L.C. Marsh. 2002. Epifluorescent and histochemical aspects of shoot anatomy of *Typha latifolia* L., *Typha angustifolia* L., and *Typha glauca* Godr. Annals of Botany 87: October 2002 Issue.

Teaching Publications

Seago, J.L. 1977. Teaching beyond the introductory course: Plant anatomy. Plant Science Bulletin 23: 6-8.

Seago, J.L., Jr. 1992. The role of research in undergraduate instruction. American Biology Teacher 54: 401-405.

Seago, J.L., Jr., and J.S. Shipman. 1993. Botany students as scientists. Bioscene Journal of College Biology Teaching 19(3): 16-20.

Manuscripts in Preparation

Seago, J.L., Jr., and L.C. Marsh. Environmental and population biology: Three decades of a course for non-majors and majors. To be submitted to American Biology Teacher.

Heimsch, C., and J.L. Seago, Jr. Organization of the root apical meristem in flowering plants. To be submitted to American Journal of Botany.

Research in Progress

Heimsch, C., and J.L. Seago, Jr. The evolution of the organization of the root apical meristem in flowering plants. This is a major study, derived from Charles Heimsch's life-long study of plant roots, which he asked me to assume, which includes my own research on root meristems, and which will be submitted to the American Journal of Botany.

Schreiber, L., K. Hartmann, J.L. Seago, Jr., H.A. McManus, and J. Broderick. Biochemical characterization of the endodermis and hypodermis of rhizomes and roots of *Typha glauca* Godr. Collaborative study with Lukas Schreiber and colleague, Klaus Hartmann, Würzburg, Germany.

Seago, J.L., Jr., and C.A. Peterson. Development and structure of the root cortex of wetland plants from different wetland habitats. Ongoing, long-term studies of many species with Carol Peterson of Waterloo, Ontario; work on *Cyperus alternifolius* nearly completed.

Seago, J.L., Jr., H.A. McManus, Jaime J. Welch, and L.C. Marsh. Development of the rhizomes of *Typha glauca*. A detailed analysis of the cortical tissues of the underground stems resulting from separate undergraduate research projects of Hilary McManus and Jaime Welch.

Reinhardt, A., and J.L. Seago, Jr. Root cortical development in *Canna*, which grows easily in wetland or terrestrial conditions. A study with Angel Reinhardt, a grad student in Education, who grows the plants at a local herb and flower establishment.

Abstracts of Talks at Professional Meetings (* = speaker); not refereed

Seago, J.L.*. 1967. Apical organization in roots of the Convolvulaceae. *Amer. J. Bot.* 54:643.

Payne, W.W.*, and J.L. Seago. 1967. The unsealed carpel of *Akebia quinata* (Lardizabalaceae). *Amer. J. Bot.* 54: 658-9.

Seago, J.L.*, C.J. Ciesla, and L.C. Marsh. 1971. Some correlations between tissue development in roots of *Lythrum salicaria* and environment. *Amer. J. Bot.* 58: 456.

Seago, J.L.*, S.M. Wolniak, and S.M. Wiatr. 1972. A re-examination of cortical development in roots. *Amer. J. Bot.* 59: 656.

Seago, J.L.* 1975. Effects of root cap excision on root and shoot growth in soybean seedlings. *Amer. J. Bot.* 62(5): 19.

Seago, J.L.* 1975. A 'problems' approach to the teaching of Plant Kingdom and Plant Anatomy courses. *Amer. J. Bot.* 62(5): 65.

Kausch, A.P.*, and J.L. Seago. 1977. A seasonal study of the tissues and organs in *Typha latifolia*: Winter starch distribution. *Amer. J. Bot.* 64(5): 11-12.

Seago, J.L.* 1977. Modifications in root apical development and root starch distribution during germination of soybean seedlings. *Amer. J. Bot.* 64(5): 19.

Seago, J.L.* 1978. The role of research in undergraduate instruction. *Amer. J. Bot.* 65(5): 10.

Marsh, L.C., and J.L. Seago, Jr.* 1983. Adventitious rooting in *Typha glauca* under experimental conditions. *Amer. J. Bot.* 70(5): 25.

Seago, J.L., Jr.*, and L.C. Marsh. 1985. Root development in *Typha glauca*. *Amer. J. Bot.* 72(6): 47.

Seago, J.L., Jr.* 1988. The origin of aerenchyma in aquatic roots. *Amer. J. Bot.* 75(6): 47.

Seago, J.L., Jr.*, and L.C. Marsh. 1989. Origin and development of lateral roots in *Typha glauca*. *Amer. J. Bot.* 76(6, suppl.): 57.

Seago, J.L., Jr.* 1990. Root tip growth of adventitious roots of *Chlorophytum comosum*. In aerial, aquatic, and terrestrial conditions. *Amer. J. Bot.* 77(6, suppl.): 24.

Seago, J.L., Jr.* 1992. Development of the root cortex. *Amer. J. Bot.* 79(6, suppl.): 22.

Seago, J.L., Jr.* 1993. The plant biology student as scientist. *Amer. J. Bot.* 80(6, suppl.): 190.

Seago, J.L., Jr.*, C.A. Peterson, and D.E. Enstone. 1994. Fluorescent and histochemical studies of cattail roots. *Amer. J. Bot.* 81(6, suppl.): 31.

Seago, J.L., Jr.*, C.A. Peterson, and D.E. Enstone. 1995. Cortex development and structure in roots of *Pontederia cordata*. *Amer. J. Bot.* 82(6, suppl.): 26.

Seago, J.L., Jr.*, C.A. Peterson, and D.E. Enstone. 1996. Development and structure of the root cortex in *Nymphoides cordatum*. *Amer. J. Bot.* 83(6, suppl.): 49.

Myers, C.V.*, C.J. Kinkaide, J.A. Schneider, and J.L. Seago, Jr. 1997. Effects of lead on early development in *Typha glauca*. *Amer. J. Bot.* 84(6, suppl.): 51.

Seago, J.L., Jr.* 1997. The root cortex in the wetland plant, *Nymphaea odorata*. *Amer. J. Bot.* 84(6, suppl.): 55.

McManus, H.A.*, J.L. Seago, Jr., L.C. Marsh, and K.I. Mohamed. 1998. Structural comparison of three *Typha* species: *Typha glauca* and its putative parental species, *T. latifolia* and *T. angustifolia*. *Amer. J. Bot.* 85(6, suppl.): 15.

Seago, J.L., Jr.* 1998. Development and structure of the root cortex of the wetland plant, *Caltha palustris*. *Amer. J. Bot.* 85(6, suppl.): 20.

Seago, J.L., Jr.* 2000. The root cortex of the water lilies and lotuses. *Amer. J. Bot.* 87(6, suppl.): 32.

Talks at Professional Meetings: Abstracts Published only in Meeting Proceedings

Seago, J.L., Jr. , and L.C. Marsh. 1987. The determinate growth of *Typha glauca*. XIV: 39. International Botanical Congress, Berlin, Germany.

Seago, J.* 1991. Scientific communication in Environmental and Population Biology. The ASB Bulletin 38(2): 92. Association of Southeast Biologists Annual Meeting, Booneville, NC.

Seago, J.L., Jr.*, and L. C. Marsh 1987. Initiation and development of lateral roots in *Typha glauca*. 20th Plant Development Workshop at Horticultural Research Institute of Canada, Vineland, ON.

Seago, J.L., Jr.* 1995. Development and structure of the endodermis and hypodermis in *Typha*. 30th Plant Development Workshop at University of Waterloo, ON, Canada.

Seago, J.L., Jr.* 1999. Developmental and structural studies on roots of wetland plants. 33rd Plant Development Workshop at University of Guelph, ON, Canada.

Seago, J.L., Jr.*, and C.A. Peterson. 1999. Endodermis, hypodermis, and permeability in wetland plant roots. XVI: 83. International Botanical Congress, St. Louis, MO.

Seago, J.L., Jr. 2001. Development and structure of the root cortex in *Cyperus alternifolius*. Botanical Society of America, Albuquerque, NM.

Seago, J.L.* , and C. Heimsch. 2002. Patterns in root apical organization and cortex structure in basal Angiosperms and Dicotyledons. Botanical Society of America, Madison, WI.

Welch, J.* , B. Doris, J.L. Seago, and L.C. Marsh. 2002. Responses of *Typha glauca* plants to increased salinities. Botanical Society of America, Madison, WI.

Published Book Review

Seago, J.L., Jr. 1980. Guedes, M. Morphology of seed plants. Plant Science Bulletin 26: 50.

Research Report: Not Refereed

Seago, J.L., and P.G. Weber. 1975. Vegetation and animal surveys. Chap. 7, p. 93-180, in LOTEL, Research Report No. 195: A biological study of a proposed dredge spoil site in Rochester, NY. Lake Ontario Environmental Laboratory, SUNY, Oswego, NY.

Professional Society Membership and Journals

Botanical Society of America - American Journal of Botany
Council on Undergraduate Research - CUR Quarterly
International Waterlily and Water Gardening Society - Water Garden Journal
Society of Economic Botany - Economic Botany
Society of the Sigma Xi - American Scientist
Torrey Botanical Society - Journal of the Torrey Botanical Society
Annual Review of Plant Physiology and Plant Molecular Biology
Environmental and Experimental Botany
International Journal of Plant Sciences
WorldWatch

Grants

State Research Foundation Grant-in-Aid, 1971-2
NSF Matching Equipment Grant, 1981 (Principal Investigator)
Experienced Faculty Travel Award of SUNY/UUP to Berlin, 1987
SUNY Oswego Summer Faculty Research Grant, 1990
NSF Grant for Root Development Symposium in Honolulu, 1992 (Principal Investigator)
SUNY Oswego Faculty Enhancement Grants, 1994, 1998, 2002
International Water Lily Society Grant, 1998

Professional Recognition

Invited talks: University of Georgia, Kent State University, University of New Hampshire, Virginia Polytechnic & State University, Queen's University (Canada), University of Bristol-Long Ashton Research Station (England), University of Waterloo (Canada), 4th Annual Conference of the Empire State Association of Two-Year Biologists at Syracuse. Invited symposium organizer for 2003 annual meetings of Botanical Society of America, Developmental and Structural Section, in Mobile, AL. Invited Symposium Organizer: 1999 XVI International Botanical Congress (Physiology and Anatomy of Roots in Wetland Environments), St. Louis, MO. Invited symposium speaker: 1987 XIV International Botanical Congress, Berlin, Germany. Who's Who in Frontier Science and Technology (1985); Who's Who: Environmental Registry (1992); Who's Who in Science and Technology (1993); Who's Who in the East (1993); Vice-Chairperson (1977-8) and Chairperson (1978-9) of Structural Section and Program Director (1994-7) of Developmental & Structural Section of Botanical Society of America.

Just since Jan 2000, professional, scholarly service as a referee in the review of numerous research articles for such journals as American Journal of Botany, Annals of Botany, Canadian Journal of Botany, International Journal of Plant Sciences, Iran Journal of Agricultural Research, Journal of Experimental Botany, Journal of the Torrey Botanical Society, New Phytologist, and Environmental & Experimental Botany (as Editorial Board member).

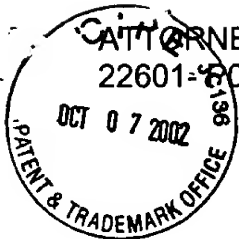
Invited contributor of cover photo on the January 1999 issue of the Canadian Journal of Botany; use of that cover photo as the home page photo for the Canadian Journal of Botany web site from 1999 thru 2001. Invited contributor of many photos in scholarly books and a review article. Outside examiner and committee member for doctoral student and masters student in biology at Carleton University and University of Waterloo, Canada.

Teaching

Courses taught in the last 20 years (most Problems in Biology also had 1-3 graduate students): Environmental & Population Biology; Plant Kingdom; Plant Anatomy and Morphology; Morphology of Non-Vascular Plants; Developmental Biology; Plants and Society; Topics in Modern Biology: Ecosystems in Jeopardy; Cytohistotechniques; Current Issues in Biology: Conservation; Biology of Sex; Introductory Biology; General Biology; Trees and Shrubs (undergrad and grad); Developmental Biology of Plants (grad); Problems in Biology (undergrad and some grad): Plant Development, Evolution & Education, Plant Tissue Culture, Plants and Acid Rain, Pollutants and Plant Development, Plant & Animal Histological Techniques, Plants in Polluted Environments, Plant Morphogenesis, Plant Growth & Development, and Plants, Pollution, & Environment. Many of my students have gone on to graduate schools and professional careers in botany or related biology disciplines.

Service

Department advisement coordinator for several years in 1970's; member, Student Affairs Council; chair, Department of Biology, 1979-1985; member of numerous departmental committees during 1970's; producer of minority, biology Self-Study in 1998 and Biology Brochure in 2001; member review committee for Explorations in the Natural Sciences; teacher in Sheldon Institute for Gifted and Talented Children (few years in early 1980's and again in early 1990's); men's cross country coach, 1982-5, and unofficial assistant with track & field, tennis, and cross country teams in 1970's; Oswego Nursery School Publicist in 1970's; leader of numerous field trips elementary school classes for nature studies; double bass player with Oswego College/Community Orchestra, 1991-2001; trombonist with Oswego Concert Band 2002-; various leadership positions with Structural/Developmental & Structural Section of the Botanical Society of America. I've been a major protector of academic rights, academic freedom, and academic and scholarly standards at Oswego and in Biology.



ATTORNEY DOCKET NO
22601-8002US

PATENT
U.S. Ser. No. 09/603,257

#9
3/4
RECEIVED
OCT 11 2002
GROUP 3600

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Smith, et al.

Serial No.: 9/660,257

Filed: 09/12/2000

Title: METHODS AND MIXTURES FOR TREATING DISTRESSED TREES

Art Unit: 3643

Examiner: Gellner



Hon. Commissioner of Patents
Box Fee Amendment
Washington, D. C. 20231.

Certificate of Mailing *Express Mail*

I hereby state that on reasonable information and belief, I expect that this *Express* correspondence will be deposited with the U.S. Postal Service as U.S. *first class* mail with sufficient postage, in an envelope addressed to the Commissioner for Patents, Washington, D.C. 20231, on the date indicated below.

[Signature]
Signature

S Taylor Gellner
Printed Name

10-7-02
Date

Express Mail Receipt No EL 859 426 9 00 US

AFFIDAVIT

WHEREAS, the undersigned,

I, John Cooper, horticulturist, resident of Denton County, Texas 76209, citizen of the United States of America, with offices at the Denton County Government Center, 306 N. Loop 288, Suite 222; Denton, TX 76209-4887 do hereby state that :

As a trained professional and practicing horticulturist I am interested in treatments to conserve and protect trees in our area and particularly our native post oaks which are so easily stressed by construction injury and especially root trauma.

I have lived and worked in Denton County as the County Extension Agent-Horticulture since 1985 and have found that the loss of post oaks due to construction injury to be the single-most

common issue I have faced from the first day on the job to the present. Post oaks are the climax species in the Eastern Cross Timbers vegetational region of Texas.

In order to help whomsoever may read this statement understand the condition of our native oak forest and the forces they endure during the process of urbanization, I am attaching a publication called, "The Care and Feeding of Post Oaks in Denton County", copies of which I provide to customers in response to calls for information which number in the hundreds per year. As anyone will see, my approach, and I consider my understanding to match that of anyone in the field, is to relieve external stresses that might impede the trees' recovery from construction injury and especially root trauma.

Nowhere in the document will you find a reference to your treatment because I have nowhere found it in the literature. As a trained horticulturist with two science degrees from the Department of Horticultural Science at Texas A&M University in College Station, I am familiar with rooting hormone. They are commonly used when rooting cuttings.

It is my understanding that your patent has been denied on the basis that rooting hormones have already been patented for use in tissue culture and for rooting cuttings. These are propagation methods and have no relation to your tree stabilization and root rejuvenation application. In hindsight, I might say, why didn't I think of this? Well, the fact is, Dr. Smith did, and I didn't.

I am not a patent lawyer and can't say I know patent laws but I can say that you have, to my knowledge, a previously untried method of rejuvenating construction traumatized trees. The nearest application to this in my mind is the inclusion of rooting hormone in "root stimulator" used to stimulate roots when transplanting trees. Planting trees is an entirely different practice from saving construction traumatized trees and the application of rooting hormone for this purpose has, to my knowledge, not been previously tried much less pursued as a standard arborological practice such as here proposed.

I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

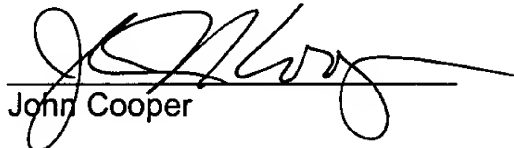
The Commissioner is hereby authorized to charge any fees or credit any overpayment to Deposit Account Number 23-2426 of WINSTEAD SECHREST & MINICK P.C.

If the Examiner has any questions or comments concerning this paper or the present application in general, the Examiner is invited to call the attorney for the undersigned, James J. Murphy at (214) 745-5374.


~~Inventor's~~ signature:

State of TEXAS

§
§
§


John Cooper

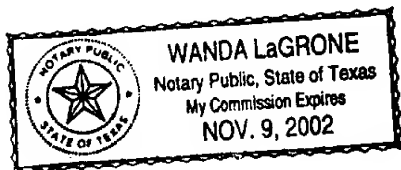
County of Denton _____

Before me, Wanda LaGrone, a notary public, on this day personally appeared John Cooper, known to me to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same for the purposes and considerations therein expressed.

Given under my hand and seal on the 7th day of October, 2002.

Wanda LaGrone
Notary Public Signature

Wanda LaGrone
Notary Public Printed Name





THE CARE AND FEEDING OF POST OAKS IN DENTON COUNTY

John Cooper
Denton County Extension Horticulturist
306 N. Loop 288, Suite 222
Denton, Texas 76209-4887
940-349-2883
jn-cooper@tamu.edu

THE ROYAL OAK

Post oaks are the crowning achievement of the plant kingdom in the Cross Timbers geographical region of Texas. Post oaks are highly adapted to our soils and climate. After all the trees we have planted, post oaks remain the dominant tree species in Denton County.

STRESSES OF URBAN BLIGHT

Post oaks have a well-deserved reputation for succumbing to the stresses of "urban blight". This tree simply cannot stand root disturbance. When a property is purchased for development and a decision is made to preserve post oak trees, one simple rule must be followed. At least one-half of the root system must be left undisturbed.

The roots of native oaks extend away from the trunk a distance equal to the tree height or twice the diameter of their limb spread whichever is greater. Using this formula, a 30 ft. tall tree would have a root diameter spread of 60 ft. but would be even greater than 60 ft. if the tree had a canopy spread greater than 30 ft. in diameter. If your objective is to save a tree, err on the side of conservation and use the larger root estimation figure.

Tree roots are not as deep as most people think. The roots that do the actual work of absorbing water and minerals are located in the topsoil. The topsoil can be a few inches or a few feet deep. A good site will have a couple of feet of topsoil and will withstand more abuse than poor sites with only a few inches of topsoil. If your site has one foot of topsoil and you scrape away the top six inches, you have reduced the volume of the effective feeder roots by half in the area you scraped. The most effective feeder roots are closest to the surface, which is where the soil is richest and the oxygen content the highest. When you scrape the topsoil away, you actually remove the most effective feeder roots.

To help reduce root disturbance during construction, set a fence up around the root area to be conserved of each tree to be protected, before moving heavy equipment onto the site. Work the area inside the fence, if necessary, with hand tools.

Because roots run radially from the trunk, even shallow trenching results in significant root losses. Utility lines can be installed in most situations by boring under trees. If the boring is done at the depth of the subsoil, i.e., below the topsoil, root losses will be significantly minimized. Considering the cost and value of trees, boring should be employed whenever utilities are installed in wooded developments.

Septic systems should be installed in areas where trees are not growing. If you do not have a place barren of trees, put the septic system where you least want trees to be growing. Septic systems kill trees. What the leach line trenching does not kill, the constant soil saturation will. Small scale sewage treatment technology for single family dwellings using aerobic digestion takes up less space than anaerobic septic systems and do not require the installation of field leach lines. The treated water is applied as gray water irrigation in the landscape. Be careful to avoid over-watering, i. e. watering more than twice a week.

If filling is required under a tree's canopy, tile aeration systems can be installed to assist air passage and gas exchange with the surface. Not all tile aeration systems are of equal value. Consult a professional before taking heroic or expensive measures to save a tree with tile aeration.

Ragged and torn roots resulting from trenching machines, backhoes, dozers, loader buckets and other heavy equipment do not repair. They simply rot back and new healthy root tissue is invaded by disease organisms. When roots are cut by trenching or other means, they should be re-cut with sharp pruning tools. This assists in regeneration of healthy roots at the ends of pruned roots.

If trees are known to be under stress, soluble high phosphorous and high potassium fertilizers can be injected into the root zone to supply developing roots. Fertilizer trunk injections should not be used. Special care also should be taken to protect against insects and diseases. Maintaining even soil moisture availability in and around the remaining intact root system will assist tree recovery.

Just as deciduous trees are best dug for transplantation in the dormant season, so is site work and soil disturbance of any kind, best done in the dormant season. Install sprinkler systems or patios, for instance, in the winter rather than the summer if significant root disturbance is likely. Make estimates of root losses and remove a commensurate amount of live wood up to, but not more than, one-third of the total foliage canopy to balance the shoots with the roots. Start by removing weak and diseased wood. Then prune the lowest limbs on the trunk which usually receive the least light and are usually the least productive in terms of returning energy to the tree.

If you are constructing a home, take pictures of "dirt work" during construction. This way, you can "recollect" the amount of root loss for each tree so you will know how much to prune off the top. After final grading, it's hard to remember.

TENDER LOVING CARE

Through the ages, our native oaks have endured the extreme weather conditions of North Texas, so we figure they're as "tough as a boot." In their natural state, post oak roots are covered by several layers of fallen leaves and rich leaf compost. We strip all that off and grow turfgrasses over their roots, which aggressively compete with tree roots for available water and nutrients. Suddenly they are no longer in a natural state. They are out of their element, so to speak.

It is better to grow ground covers, such as English ivy and Vinca, rather than turf under trees. This allows you to water less and allows the leaves to fall and nestle into the groundcover creating the natural leaf litter mulch to which they are accustomed and adapted. When planting ground covers do not till the ground under the trees. To prepare the soil for planting, simply spread a three or four inch deep layer of well-rotted compost over the ground to be planted and insert two, three or four inch pots of ground covers directly into the compost. Flowers planted under trees should also be planted in the same manner to avoid root damage. Never till the ground under native oaks if you can possibly avoid it.

Post oaks and blackjack oaks are among the last trees to leaf out in our area. They are also among the earliest to finish growing each spring. Fertilizing your native oaks early will help them take better advantage of their short growing season by putting on more leaves and making each leaf bigger. This means more shade and healthier trees in the summer. Use a balanced fertilizer on mature trees. High nitrogen fertilizers may stimulate excessive growth, thereby depleting reserves on already weakened trees.

Broadcast five pounds of 15-5-10 or equivalent fertilizer per 1,000 square feet of effective rooting area in at budbreak in late March or early April and repeat the application every six weeks as long as new growth is flushing out at the

shoot tips. The effective root area extends in all directions as far from the trunk as the tree is tall. Late growth flushes may occur as late as June in wet years. If you are growing ground covers under the trees, forget the fertilizer and simply broadcast one inch of well-rotted, finely-screened compost every six months anytime during the year. This will be adequate for both trees and ground covers.

Water management under our native oaks is important to their long term health. Most often we irrigate according to the needs of our turf instead of our trees. Turf is commonly irrigated twice a week which is not necessary for turf except in cases of the coarsest sands. Applying one inch of water once a week in the absence of rain for your turf. This will be sufficient for your trees but if you will put out two inches every third or fourth watering this will encourage deeper rooting of your trees. The minimum for good maintenance of native oaks, during the growing season in the absence of rain, is a single, two-inch application of water once a month. This is only possible when turf is not used. Watering more often than once a week is detrimental to native oaks. You can never put too much water on trees; you can only water too often. When you water, water deeply.

THE THREAT OF PESTS

Because native oaks in developed home sites and businesses are already under stress, additional stress from insects and diseases can sometimes be fatal. Making periodic inspections of foliage for signs of insects and diseases throughout the growing season will often help you spot a problem before serious harm is done.

Among the pests most likely to threaten your native oaks are scale, plant bugs, cankerworms, aphids, lacebugs, mites, borers and anthracnose. Each alone can cause serious tree health problems. In combination and in association with other stress factors, a particular insect or disease pest can strike the fatal blow.

Perhaps the single most beneficial spray for native oaks is dormant oil. This spray, applied during the dormant season helps control one or more overwintering stages of scale, plant bugs, aphids, lacebugs and mites, virtually every major pest except cankerworms and anthracnose. The dormant oil will not eliminate these pests but will reduce their numbers so the need to spray hard pesticides during the growing season is less likely.

Young developing spring leaves are tender and susceptible to anthracnose, plant bugs and cankerworms. A close inspection of your tree's foliage from budbreak through May will help you discover any developing problems with these pests.

Hypoxyton Canker

There is no known disease that kills perfectly healthy post oaks in a matter of weeks or months. The oak wilt fungus is such a disease on live oaks and red oaks but post oaks are not susceptible to the oak wilt fungus. Another fungal disease, hypoxyton canker will kill apparently healthy post oaks in a matter of weeks or months. The operative word here is "apparently" because hypoxyton canker only attacks weak trees. It is the final stage, "the straw that broke the camel's back", "the last out in the ninth inning", in a stress syndrome known as oak decline.

Near death or shortly after limb or tree death from hypoxyton the outer bark sloughs off and exposes large masses of brown, dusty one-celled spores on the trunk or dead branches. These spores are gone within a few weeks and the infected surface turns a grayish-silver. Gradually this area erupts into numerous black fruiting structures. Mature fruiting structures forcibly discharge sexual spores which are blown to surrounding trees where new infections may occur. Entry appears to be through injured surfaces on limbs or trunk. The fungus grows best at 86° F., but can grow at 50° F. and 100° F. Spread to other trees may be reduced by cutting down trees infected with hypoxyton as soon as they die and storing their wood as firewood under a clear plastic film to keep the spores and bark beetles from discharging the fungus.

In virtually every case, hypoxyton canker only hastens the death of trees. As weak as a tree must be to fall prey to this disease it most probably will soon die of exhaustion anyway. The strategy for prevention of this disease is to understand oaks and their cultural preferences and treat them with respect so they have a chance to naturally fight off infection.

Trees are stressed from a combination of factors including root disturbance, overwatering, drought, heat, shading, lack of winter chilling, insects, herbicides, etc. Trees continually under stress from one or more stress factors eventually decline in energy reserves which are stored as starch grains in sapwood. In a depleted energy state, trees can no longer resist the weak pathogenic activity of the hypoxylon fungus and the fungus takes over almost overnight.

The bark is cleaved from the tree by a sudden growth and swelling of a mat of fungal spores revealed as a mass of olive green or tannish brown dust formed over the sapwood. These spores which are the "seeds" of the disease are released to the air and blow around in the environment. Many of the spores land on neighboring trees. Nearby weak trees may serve as susceptible hosts for the fungus, contracting the disease, and in turn, spreading the epidemic further still, repeating the cycle of death.

Wide growth rings translate into good stored energy reserves. Narrow growth rings translate to low energy reserves. Growth rings are reflected in the annual shoot growth. The length of annual shoots in full sunlight at the periphery of the canopy should be six inches or longer. Trees with less than 3 inches of annual shoot growth at the periphery of the canopy exposed to the full sun indicate narrow growth rings and a low energy state and consequently subject to the ravages of this weak but opportunistic fungal pathogen in the genus, *Hypoxylon*.

As weak as a tree must be to fall prey to hypoxylon it most probably would soon die of exhaustion anyway if growing, climatic, and/or cultural conditions do not improve. If, however the tree is in the balance, and the growing conditions do improve before it contracts the fungus then it may recover and go on to live a normal, healthy life.

The strategy for controlling hypoxylon is to reduce the number of spores in the vicinity by removing the infectious trees and improving the cultural conditions for those still living. Trees showing signs of active cankers should be cut down and covered with a tarp or plastic sheeting to prevent release of spores to the environment. The wood can be pushed and burned because the heat kills the spores but if it is kept for firewood it should be covered until the cankers turn silver.

Fertilize any tree, including post oaks, at the beginning at bud break in late March or early April with five pounds of 15-5-10 per 1,000 square feet of effective root area which extends in all directions, as far from the trunk as the tree is tall. Repeat the application at six-week intervals so long as new growth is appearing at the shoot terminals throughout the spring and early summer.

If you do not have turf under your trees, one of the best things you can do for them is to spread two inches of well-rotted, finely screened compost over the root area and then add one additional inch of compost every six months thereafter. This simulates the natural leaf litter mold ground conditions to which they have become accustomed over the last few thousand years. This compost layer not only supplies the minerals the trees need but acts as a mulch to keep the roots cool, moist and functioning.

Optimally post oaks should receive two inches of water once every ten days throughout the summer in the absence of rain. If you have turf under your trees, apply one inch of water per week for the turf and then apply an extra inch every third watering to reach the deeper roots of the trees. On particularly sandy soils you can tighten your watering interval to every five days if your turfgrass is stressing. Consider replacing turf under trees with less competitive mulched, broadleaf evergreen ground cover beds and water once every ten days.

Anthraconose

Anthraco

nose is a fungal leaf spot that reaches epidemic proportions under high rainfall conditions. Numerous brown spots about one-quarter of an inch across appear on the upper leaf surface in the spring and summer. A fungicide containing chlorothalonil, applied when leaves are half grown and repeated 10-14 days later, will help protect trees from initial spring infections. Subsequent sprays may be necessary during periods of excessive rainfall especially in late spring or when summer growth flushes occur. Occasionally, several days (3-5 days) of continuous wet weather occurs under mild temperatures (80-85 degrees F.) during the summer and even mature leaves will be infected. The cases are rare, but fungicide applications made immediately following the wetting period may help.

Lacebugs

Lacebugs are the number one insect threat to native oaks in our area. Lacebugs seriously weaken oaks and even occasionally kill them. These tiny insects suck sap from the underside of leaves. As the feeding continues, the upper leaf surface assumes a grayish cast.

If the leaves on your native oaks appear unhealthy, inspect the underside of the leaves for lacebugs. Adult lacebugs are mostly off-white, about 1/8 inch long, flattened and rectangular. Nymphs are smaller, wingless, more oval with a mottled, chocolate-brown and off-white coloring. In an exploding population, nymphs typically out-number adults by a wide margin.

Numerous tiny jet-black eggs no larger than a speck can be found in loose clutches of a dozen or more. A thin shellac cements the eggs to the bottom of the leaf. Add a few white cast skins from nymphal molts and you have the grisly scene complete.

Lacebugs develop rather quickly, taking only 30 days to go from egg to adult. Five or more generations may pass in a year's time. Oak lacebugs overwinter as eggs and adults. Nymphs and adults begin feeding on new foliage in the spring. By July, their numbers have usually grown to detrimental levels. Continued feeding into the fall results in significant weakening of infested trees.

If lacebugs are found, consideration should be given to spraying. Knocking the population down early will lower the number of eggs and adults in succeeding generations. Preserving existing foliage through the end of October will help save energy for the following spring's leaf crop. Our native oaks have one primary growth flush each year. If they miss it, they've had it. Lacebugs can be controlled with insecticides containing imidacloprid such as Merit® or Bayer Advanced® Tree and Shrub Insect Control. Two or three applications at 10-14 day intervals are required to kill all stages of the insect. As with any insecticide application, thorough coverage using the prescribed rate is essential for effective control.

Aphids

The second most injurious insect to native oaks is the aphid. This tiny, soft-bodied insect, ranging in color from yellow to red or black, may number in the hundreds per leaf. Nymphs and adults up to one-eighth inch in size suck sap out of the foliage making the leaves wet and sticky.

Aphids feed on the underside of the leaves. Although they appear the worst in the early fall, they may reach damaging populations at any time during the growing season.

Periodic inspections throughout the growing season will reveal the presence of aphids. If sap is falling from the trees and making the ground sticky below the tree, you have aphids and probably need to spray. Insecticides containing acephate found in Orthene®, dimethoate found in Cygon®, or malathion should be applied at 10-day intervals as needed for control. Insecticidal soaps have also been shown to work well on aphids and is less toxic than the aforementioned insecticides. Remember the sugars aphids remove in the fall could be stored for next spring's shoot growth. If aphids are damaging as late as early October, it would be wise to spray.

Plant Bugs

Running a close second behind aphids and lacebugs are plant bugs. These are tiny green or brown insects in the stinkbug family about one-eighth to one-quarter inch long. They feed by sticking a long needle-like stylet into the leaves and sucking sap from the leaves.

After feeding, a tiny brown pinhead sized spot surrounded by a bright yellow halo is left at the puncture site. As the leaf expands, the leaf tears at the puncture site creating irregular holes ranging up to one quarter-inch across.

Infested leaves are often dwarfed, puckered and twisted. The greatest damage occurs during the three-week period between budbreak and full leaf expansion in the spring. An insecticide application made soon after budbreak and repeated 10 days later will significantly reduce their damage.

Usually, plant bugs are discovered too late to control in the current season. The probability is strong they will be a problem next year if they have reached damaging levels in the current season. Scheduling plant bug sprays for the following spring is advised for trees showing significant damage in the current year. Use carbaryl found in Sevin® for control.

Mites

Mites are a serious health detriment to our native oaks. They are tiny, nearly microscopic (you need a magnifying lens to see them), eight-legged arthropods. They are not actually insects and are more a kin to spiders and ticks than worms and aphids. The most famous garden mite is the red spider mite.

All mites rasp leaf tissue and suck leaf juices. They congregate along the sides of major veins but may be found wandering anywhere on the leaf. Several species feed on the bottom and top of oak leaves.

The same specking and loss of chlorophyll called "bronzing", associated with mite feeding on tomatoes and marigolds, appears on oaks as well. After the first signs of bronzing, make a close inspection for mites using a 10X or greater magnifying lens. If mites are found, spray twice, 5-7 days apart with dicofol found in Kelthane®, fenbutatin found in Vendex® or cyfluthrin found in Bayer Advanced® Home and Garden Spray. Mites can go from eggs to adults that lay eggs in as little as one week. Eggs are not controlled with insecticides so the second spray applied within a week of the first application is essential for satisfactory control. Three sprays may be required for particularly heavy infestations.

Scale

Limbs, pencil-sized and up, are often covered with tiny, aphid-like insects with a small flattened disk-like covering called scale. Scale insects over-winter as eggs which hatch in the early spring and crawl to neighboring, expanding shoots where they sink their sucking mouthparts and begin feeding. Once they attach and start feeding, they excrete a waxy coating which covers their body. The scale covering is all you see on the stem. Scale range in size from the head of a pin to one-eighth inch or more and in color from ash-gray to reddish-brown.

Scale insects draw sap from the trees and weaken them. They are often associated with stem or branch junctures or stem nodes but may be found anywhere along the stem or branch down until the bark turns thick and rough.

Dormant oil is the traditional control for scale, and thorough applications are effective. Spring applications of malathion mixed with summer oil should be applied during the tree's active spring growing phase. This is when the eggs hatch and the nymphs crawl to new stem tissue, and before they settle in and exude their waxy covering. If scale is discovered during the summer and the infestation is severe, spray malathion, acephate, or imidacloprid with summer oil if the temperature is below 85°F for 72 hours following the spray. If temperatures exceed this level, drop the oil from the spray or tree damage could result.

Cankerworms

In the spring and summer of 1978, cankerworms completely defoliated all the oak trees in a 100 mile-wide band running to the west of I-35 from south of San Antonio to north of Fort Worth. In the following spring, 1979, a similar episode occurred but only about half as many trees defoliated. An outbreak of this magnitude has not occurred since. The threat remains, however, and each year, isolated trees suffer significant degrees of defoliation that could benefit from treatment.

Cankerworms are a type of inchworm much like the cabbage looper. Cankerworms are not the light green of the looper but are the same size, about one inch long. They move by hunching their back and looping out in front, measuring an

inch with each "step."

The first sign of cankerworms is a delayed budbreak. You keep waiting for the trees to come out in the spring but they never put on leaves. If you look closely, however, the worms are simply chewing the leaves off as soon as they push out of the bud. Some trees will begin growth but seemingly "reverse" growth, having less foliage than the day before.

If you suspect cankerworms might be infesting your trees, take a closer look. Bump some limbs. If there are very many they will fall out of the tree and be suspended by long silken threads, kind of like bungee jumping for worms.

If cankerworms are found in any numbers, spray with insecticides containing the microbial insecticide *Bacillus thuringiensis* also known as BT. Worms will take three days to die but they will become sick and stop feeding within a few hours of ingesting the first bite. Inspect the trees one week later for a resurgence of worms and spray again if necessary.

Borers

Borers do not attack healthy trees. They will attack weak trees, i. e. those in the balance. Borers can tip the balance and be the final cause of tree death. If your trees are putting on less than 3-4 inches of annual shoot growth they should be sprayed for borers as protection.

Borers come in a range of sizes that fall into two general categories: roundheaded borers and flatheaded borers. The larvae of roundheaded borers burrow throughout the tree trunk including the heartwood. The larvae of flatheaded borers tunnel in the xylem wood just beneath the bark. They both cause serious damage.

Borers emerge from trees as adults from April through September to mate and lay eggs for the next generation. The larvae enter the wood of the tree soon after hatching from the eggs. Once the borers enter the tree they cannot be controlled and will proceed to develop within the tree.

If your oaks are stressed they should be treated to prevent borer damage. Apply a soil drench of imidacloprid found in Merit® or Bayer Advanced® Tree and Shrub Insect Control at the first sign of budbreak in the spring.

Oak Wilt

The only disease that will kill a perfectly healthy native oak tree is oak wilt, *Ceratocystis fagacearum*. This fungus will infect and kill perfectly healthy blackjack oaks but does not infect post oaks. Fortunately, only one in twenty native oaks are blackjack oaks. The remainder are post oaks. Furthermore, blackjacks are so scattered that, so far, no oak wilt epidemic has been discovered in this tree species, only isolated trees have been infected.

Although it is highly unlikely that your trees have or will ever contract oak wilt, it would be good to identify your trees as either post oak or blackjack oak to know if the possibility even exists. Although several differences can be observed in the trees, including a darker, almost black, bark on blackjack trees, and a more pendulous branching habit, the most distinguishing feature is that the mid-vein that feeds each leaf lobe terminates at the leaf margin in the post oak. In the blackjack oak, the mid-vein feeding each leaf lobe extends beyond the leaf margins and terminates in a fine, pointed but supple, down-turned cat's claw.

If you have a blackjack oak that appears perfectly healthy and then dies suddenly in a period of only three to eight weeks, then the possibility exists that your tree died of oak wilt. Oak wilt can only be confirmed by laboratory diagnosis. If you think your trees may have oak wilt, contact the Denton County office of the Texas Agricultural Extension Service for instructions about taking oak wilt samples.

If you receive a laboratory report with a positive diagnosis for oak wilt and you have other blackjack oaks in the vicinity, you may want to treat them for oak wilt to keep them from contracting the disease. Currently the only treatment for oak wilt is to inject Alamo® fungicide into the root flares and this must be done by a trained professional. Blackjacks die so soon after they are infected with oak wilt that they need to be treated before they contract the disease.

IN SUMMARY

Our native oaks possess an inherent will to live and will do their best to survive whatever circumstances they encounter. Sometimes, try as they might, the challenges we place before them are insurmountable. Except for oak wilt which does not attack post oaks, there is no single disease that takes our native oaks out and there is no magic pill that will restore their health. They are subject to the vicissitudes of life and must struggle to overcome them, preferably with our assistance rather than our antagonism.

Following the initial trauma of construction and landscape establishment, tree health and vigor must be restored, slowly, over time, by the tree itself gathering strength. This can happen only if the needs of trees are understood and adequately met.

For all the worry they cause, our native oaks are among our most beautiful, plentiful and long-lived trees. By exercising caution during construction, watching our watering habits, making timely applications of fertilizer or well-rotted compost, and spraying for insects and diseases when necessary, our native oak forest will persist for generations to come.

When we develop a new oak forest for housing we tend most often to remove the young trees and leave the large, mature oaks. All living things have a life span and many of the mature oaks we select are actually entering old age when their life span may not be too far from running out. As trees reach maturity and old age their canopies tend to flatten out on top and they grow more broad than tall. Crowded trees, of course, do not spread out but simply expire, and at an earlier age.

Shoot length becomes ever shorter as vigor and vitality drop in a tree. Strong, healthy oaks will have shoot length of 6-10 inches. You can look at any tree and examine the length of shoot for the past five or six years and see how the tree has fared over time. Many times you will see a declining tree, whether from old age or abuse, which has several years of accumulated shoots that average only one to three inches of growth before they die. Shoot length is a good measure of the general health condition of a tree. A tree with less than 3 inches of shoot growth is declining in vigor and a tree with 3-6 inches of shoot growth is in the balance.

In the natural setting young trees replace old trees as they die. All trees, even oaks eventually die. Since we do not have young trees coming up through the forest floor to replace the aged and dying, we need to plant new trees to take their place.

The single best replacement tree for our native oaks is the bur oak. Of the trees in the commercial trade the bur oak is in every respect the closest in form and habit to the post oak itself but, contrary to the post oak, is one of the fastest growing trees we can plant.

Other desirable shade trees suitable for planting are bur oak, live oak, shumard oak, chinquapin oak, pecan, bald cypress, cedar elm, lacebark elm, Texas ash, fruitless cultivars of osage orange and Chinese pistache. Most Denton County soils in which post oaks are native are also suitable for growing sweetgum and red maple which are also recommended. Although shorter-lived, several smaller ornamental understory trees such as redbud, yaupon holly, southern wax myrtle, possumhaw holly, Eve's Necklace, Carolina Buckthorn, Rough-leaved Dogwood, and Mexican Plum are also highly suggested to fill gaps in the forest cover. Proper planting and after care methods are essential to successful establishment of any tree and should be studied, understood and followed carefully to prevent lost time and money. For information on young tree planting and establishment contact the Denton County office of the Texas Agricultural Extension Service.

The information given herein is for educational purposes only. Reference to commercial products or trade names is made with the understanding that no discrimination is intended and no endorsement by the Cooperative Extension Service is implied.

Educational programs of Texas Cooperative Extension are open to all people without regard to race, color, sex, disability, religion, age or national origin.

inc 03/02



#9
4/4

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Smith, et al..

Serial No.: 9/660,257

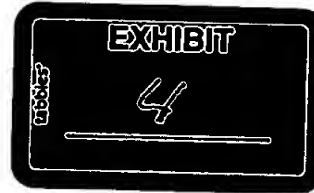
Filed: 09/12/2000

Title: METHODS AND MIXTURES FOR TREATING DISTRESSED TREES

Art Unit: 3643

Examiner: Gellner

Hon. Commissioner of Patents
Box Fee Amendment
Washington, D. C. 20231.



RECEIVED
OCT 11 2002
GROUP 3600

Certificate of Mailing *Express Mail*

I hereby state that on reasonable information and belief, I expect that this *Express* correspondence will be deposited with the U.S. Postal Service as U.S. ~~first class~~ mail with sufficient postage, in an envelope addressed to the Commissioner for Patents, Washington, D.C. 20231, on the date indicated below.

[Signature]
Signature

Staylor Gellner
Printed Name

OCT 7, 2002
Date

Express Mail Receipt No.
EL 859426400 US

AFFIDAVIT

WHEREAS, the undersigned,

I, Peter Martin, resident of 413 Meng Circle, Denton County, Texas 76209, citizen of the United States of America, having invented certain new and useful improvements in METHODS AND MIXTURES FOR TREATING DISTRESSED TREES, do hereby state that :

Since Spring, 2001, Don Smith and I, as well as various contractors, have treated hundreds of trees on dozens of sites using the mixtures and methods described in the patent application. The results have been remarkable. Our sample currently demonstrates that over 90% of trees treated survive and in many instances the survival rate is 100% while adjacent untreated properties with trees show mortality rates of 40% to 60%.

This is something that homeowners consider to be valuable especially in the light that a wooded lot costs ten of thousands of dollars more than an unwooded lot.

During the past growing season we have sold between \$5,000 and \$10,000 worth of services per month using these treatments and interest continues to grow.

I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

The Commissioner is hereby authorized to charge any fees or credit any overpayment to Deposit Account Number 23-2426 of WINSTEAD SECHREST & MINICK P.C.

If the Examiner has any questions or comments concerning this paper or the present application in general, the Examiner is invited to call the attorney for the undersigned, James J. Murphy at (214) 745-5374.